THE FOUNDRY

Volume 53
Number 5

CLEVELAND, OHIO, MARCH 1, 1925

Published
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Many Castings Required To Make Boards

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Castings Mark the Trail From the Forests to the Yard

the establishment of foundries near the mills. While the scene of lumbering and saw mill operations has changed from the early day, in some sections the industry still assumes large proportions. There are about 23,200 saw mills in the United States producing approximately 34,000,000,000 feet of lumber, with $1,000,000,000 capital. The principal lumber producing states named in order of production are Washington, Oregon, Louisiana, Mississippi, California, Arkansas, Alabama, Texas and North Carolina.

Find Where Castings Can Be Sold

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Who Is To Blame

for the

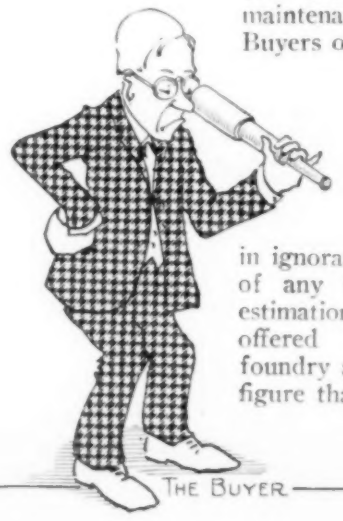
P. A.'s Slant on Buying Castings?

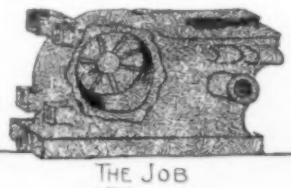
By A Victim

WHILE foundrymen generally are willing to ascribe many of their trials and troubles to the purchasing agent, the majority are fair minded and are willing to recognize their own short-comings. Purchasing agents some of them at least, may be steeped in profound ignorance regarding the difference between different castings made from various analyses and insist on buying them on a strictly pound basis. Many foundrymen know little about their costs and therefore they are in no position to make intelligent quotations.

Another factor enters here further to complicate an already chaotic state of affairs. Some excuse may be offered for foundrymen who do not know their costs, for engaging in a dog-eat-dog fight for available business. They throw all reason to one side and apparently are governed solely by the same silly motive that causes a boy to refuse to accept a *dare*. Lineal descendants of Don Quixote, they are out to show the world that their competitors are not the only people who can run tilts with windmills.

However, when foundrymen who are *familiar* with their costs, enter the same class occasionally, then indeed it may be said that the top blows off the tent and the whole works flies away. These men justify their action on the plea that work is slack, orders for castings are lacking, they want to carry their workmen and provide some means of absorbing some of the overhead burden. The various arguments yield a somewhat specious ring and partly soothe the conscience of those who employ them. They exercise an entirely different effect on other foundrymen who also know their costs and who see in this practice an insidious menace to the maintenance of fair prices. Buyers of castings are not interested and do not inquire too closely into the cause responsible for a low quotation. In some instances they may prefer to remain in ignorance. The only factor of any importance in their estimation is that castings are offered by one foundry at a lower figure than that of any other foundry. That is sufficient for their purpose. They not only secure their castings from that source, but they also brandish the figures in the face of all the foundries in the neighborhood. If not in the face of all, then at least before any foundries with sufficient hardihood to seek a share of the business.





Hard to Come Back

Probably the most aggravating feature in connection with the practice is the manner in which the purchasing agent capitalizes it, not only while it is in existence, but afterward. He is acting strictly within his rights and in accordance with recognized commercial procedure when he buys from the lowest bidder. No legitimate objection can be advanced if he chooses to parade his figures with a view to intimidating or coercing other foundrymen. However, when the purchasing agent continues to harp on certain figures after they have been revised upward, or when he deliberately tries to mislead a salesman by quoting figures that only have existence in his imagination, he no longer is conforming to accepted trade ethics.

Looking at Both Sides

THE mutual attitude of the purchasing agent and the foundryman in their relation each to the other resembles the familiar circling tactics displayed by two strange bull dogs on their first meeting. This article, the second in a series of three presenting the foundryman's viewpoint, directs attention to some of the abuses which have been responsible for this attitude. Realizing that two sides exist and that foundrymen in no sense are free from all blame, The Foundry will welcome an expression of opinion from the purchasing agent fraternity. The purchasing agents' viewpoint will be accorded the same courtesy of presentation, anonymously if desired. This interchange of ideas should result in better mutual understanding.

—The Editors.

Prices, Like Things, Are Not Always What They Seem.

He is in the sharp practice class and only has himself to blame if eventually some foundryman, with a grievance real or imaginary, slips under his guard and nicks him cruelly. Many customers through ignorance of foundry practice, and other customers either through thoughtlessness or carelessness cause foundrymen to lose money on jobs that confidently were calculated to yield a profit. A customer asks for a quotation on a certain casting which he claims he is going to use in large quantities. The foundryman knows that by installing special rigging or equipment he can secure an output that will justify a quotation below the ordinary. He receives the order but not the order he anticipated. The customer decides that a month's supply will be sufficient to order at one time instead of the year's supply which he had announced.

The foundryman makes the required number and delivers them at a loss. He depends on continued orders to yield him a profit after the cost of the special equipment has been absorbed. Usually a certain amount of experimenting is required on a new job before it is placed on a maximum production basis. With the beginning of the second month all the difficulties have been ironed out, patterns are working smoothly and the men are accustomed to the work. All the factors indicate that the job will pay a profit on the second and succeeding months. Then the customer calmly announces that he has decided to place the work with another foundry and the first foundryman has no redress.

Both Lose Money

Any one of several factors may be responsible for the customer deciding to shift his work from one foundry to another. The main reason for making a change of the foregoing typical character is due to a popular failing among foundrymen that probably has caused more trouble and wrecked more foundries than all other causes combined.

The second foundryman learns that the first man has offered to make the castings for, let us say 5 cents a pound. Without the slightest knowledge on which to base an opinion he offers to make them for 4½ cents. The customer or his purchasing agent sees a chance to save some money and promptly places his order with the second man. The net result is that both foundrymen lose money, the customer gets unsatisfactory service in his deliveries and seeds of hostility are sown that sometimes bloom into a species of plant that becomes recognized as a public nuisance.

If the second foundryman knew that the first man had prepared special rigging and had submitted an estimate on a basis that only would yield a profit on a long continued run, he might have done a little investigating before submitting a lower bid. But, that kind of work involves time and tiresome calculation and might interfere with his golf program. Why should he bother with details when a good guess will serve his purpose? He reasons that the first man must have expected to make a profit at 5 cents and therefore he is sure that at 4½ cents, he also can make a little profit. If he cannot make a profit, he is certain that at least he can come out even. The future is rather vague, but if he comes out even on the first lot he feels quite sure that subsequent orders will yield him a profit.

Omit the Raspberry

According to one prominent general jobbing foundryman, the purchasing agent would serve his company to better advantage by cultivating the friendship of one foundryman than by antagonizing a dozen. Where a proper spirit of co-operation is manifested, the foundryman frequently is in a position to suggest changes that will reduce the price of the casting per piece although not necessarily per pound.

Where the purchasing agent adopts an arbitrary attitude and knows no other unit of measurement than the cent or the fraction thereof, the foundryman usually suffers no scruples of concience in taking advantage of him at any favorable opportunity.

In justice to the great majority of foundrymen and purchasing agents who conduct themselves with deference to the rights of others and who govern themselves according to a commendable code of ethics, it is only fair to state that the incidents selected for illustration are somewhat exceptional. They are presented rather as extreme instances than as typical examples of everyday practice.

To test out a pet theory or for any other reason, a purchasing agent sometimes calls for a sample casting before letting an order. He weighs the casting carefully and on that basis offers to pay a definite price per casting. For example the casting weighs 100 pounds and he considers that 5 cents a pound is a fair price, he offers to pay $5.00 each for the castings. If the foundryman does not think the price is just and if he knows through experience that argument and expostulation are useless he may adopt measures of his own to adjust the scales of justice to his liking. The casting is made considerably lighter either by shaving the pattern or by increasing the size of the cores.

Collapse of a mill floor in a New England town several years ago was traced to defective cast-iron columns. The metal thickness near the ends was 1 inch, the full thickness required, but for the remainder of the distance the size of the core had been increased and had reduced the thickness of metal to ½ inch. Even at that thickness the columns would have been reasonably safe, but investigation disclosed that the cores had not been properly chapleted and had sprung in the center so that metal thickness on the drag side had been increased to ¾ inch while that on the top had been reduced a corresponding amount to ¼ inch. Naturally, the foundry in which the columns were made came in for a great deal of censure and no reasonable person will deny that the censure was deserved, particularly on account of the

carelessness observed in anchoring the cores to secure an even thickness of metal. Opinion may be divided on the degree of culpability involved in reducing the thickness of metal. Competition among building work foundries, encouraged and promoted by contractors and their purchasing agents had reduced prices on this class of castings to a point that approximately the only profit accruing to the foundryman was derived from the amount of metal saved on each casting.

Under the mistaken impression that uncertainty is a powerful whip to force concessions, the purchasing agent will order his patterns taken from one foundry and conveyed to another. The castings may be satisfactory and he gives no direct reason for making the change. In a more or less indirect manner, he conveys the impression that he is getting better terms elsewhere.

In some instances the foundryman views with relief the withdrawal of certain patterns, but in the majority of cases he prefers to hold them. If necessary he is prepared to make slight price concessions. Probably the job has been developed to a point where increasd production has reduced the cost.

Under legitimate emergency conditions foundrymen are ready and willing to co-operate with a customer in pushing a rush order through, even though it interferes with the regular program and increases the cost to some extent. This kind of service is an accommodation or a priviledge and naturally the foundryman resents any abuse of it. His temper and his degree of respect for the purchasing agent are not increased when he is asked to rush a lot of castings through his shop, particularly when he discovers the castings unused in the customer's yard or store room long after they were delivered on rush schedule.

Merit Is Rewarded

The majority of purchasing agents, are qualified by training and experience to order castings on an intelligent basis. They have studied the subject sufficiently to understand, in a general way, the sequence of operation involved in the manufacture of castings, also the time required. With this class the foundryman has little trouble.

In the industrial world, a constant change is taking place in the personnel. Young men are advanced to positions of responsibility to replace men who are retiring either voluntarily or involuntarily. Many of these young men have the proper qualifications and eventually perform the duties of their office in a highly creditable manner, but it would be idle to claim that they can jump on to a higher perch than the one they occupied and maintain their equilibrium without more or less preliminary fluttering of their wings.

Movies and correspondence schools to the contrary, a young man does not become an efficient and highly salaried purchasing agent by the simple expedient of moving across the hall into an office with *Purchasing Agent* in gilt letters on the door.

Under a monarchial form of government the ruler lays the flat of a sword across the shoulder of an ordinary citizen and by that simple act converts him into a knight. In the realm of industry the same idea is back of the method employed although the sword is omitted. Sometimes as in the case of the knight, the recipient of the honor is rewarded for meritorious conduct and sometimes, still following the same comparison, the reward is granted through motives of expediency.

Trouble Makers

Knowledge of markets and manufacturing proces-es are essential to the man who is buying castings or any other commodity. This knowledge may be acquired, but it cannot be acquired instantaneously and it cannot be acquired without a reasonable amount of effort on the part of the recipient. The blow from a sword blade or the conferring of a title may serve definitely to set a man's rank but it does not affect his mental capacity nor does it transform a grub into a butterfly.

Usually it is while the puchasing agent is in the chrysalis stage that he attains his maximum virulence and becomes almost as popular as poison ivy with the foundrymen who come into contact with him. Combined pressure from within and without eventually cracks his shell, in the majority of cases, and he steps forth mellowed and refined, a useful member of the industrial army. He knows what's what and neither asks nor expects the impossible.

Naturally, a certain percentage never develop beyond the chrysalis stage. They rather pride themselves on the fact that they are not like other men, weak, scatter brained, willing to veer with every wind that blows. No, Sir! When their minds are made up they are made up. Like a certain royal family which for a time cut a fairly wide swath in Europe but which disappeared in the swirling tail race of a national revolution, they learn nothing and forget nothing.

Metal Strengthens Plaster Patterns

BY WILLIAM F. LUTHMANN

USUALLY a plaster pattern only is used in an emergency and where only a small number of castings are required. Occasionally an arbitrary time limit involves the production of a considerable quantity of castings before a proper wood or metal pattern can be prepared. The main objection to a plaster pattern is that it is too fragile to withsand rough usuage. The corners and sharp edges soon become chipped and the pattern easily is broken under the rammer. The following method of coating plaster patterns with a thin metal skin converts them for all practical purposes into metal patterns.

After the plaster patterns is finished it is dipped into a bath of slow boiling wax until it has soaked up a sufficient quantity to render the surface impervious to moisture. Then it is painted with a metallic substance in the form of unlacquered bronze to serve as a conductor of electric current. It is advisible to apply two or more coatings of unlacquered bronge to insure a perfect metallic contact over the entire surface of the treated pattern.

Even though the art of electroplating is comparatively old the practitioners still have little vest pocket secrets. Where the amount of work may warrant the installation of a plating outfit, the patternmaker may do the work in his own shop. However, the practice is tricky and usually he will receive more satisfactory service by entrusting his work to those who conduct professional establishments of this character.

In this connection it is pertinent to

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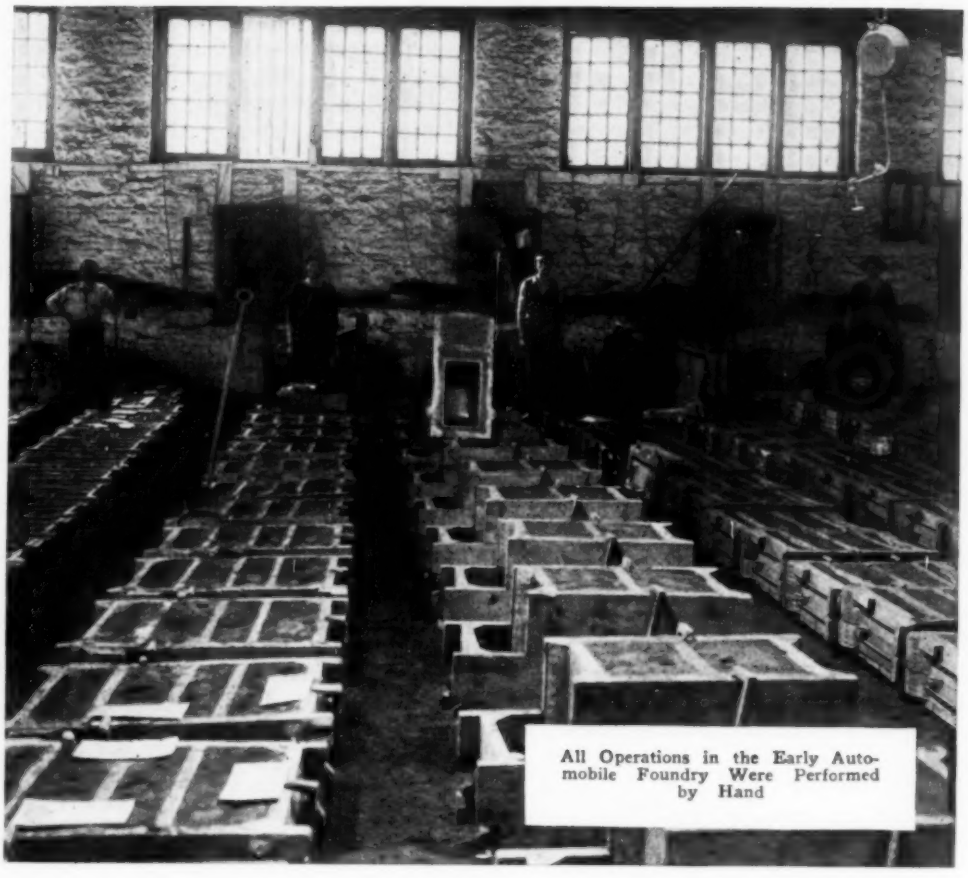


All Operations in the Early Automobile Foundry Were Performed by Hand

Foundry Refinements

By Albert Weber

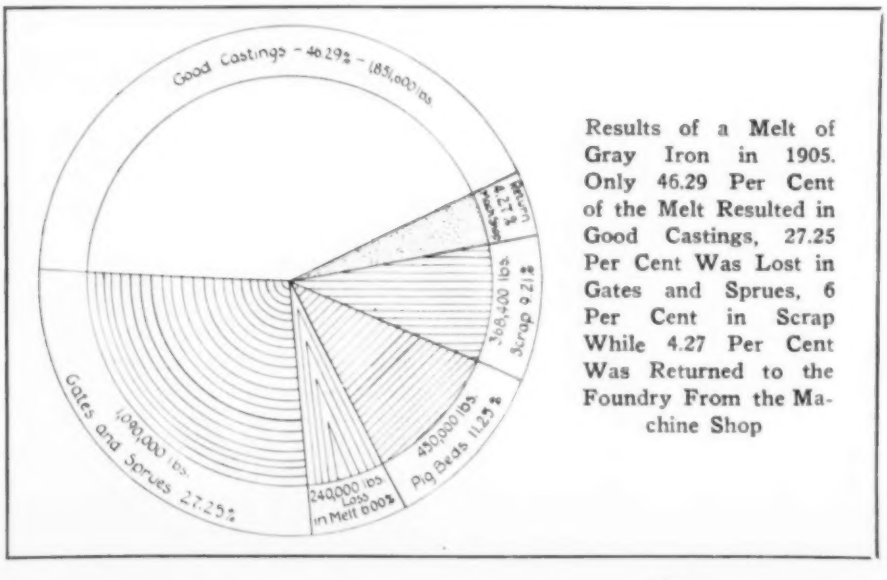
A PASSING glance is sufficient for one to visualize the rapid development that has taken place in automobile manufacture since the birth of the gasoline vehicle scarcely a score of years ago; a growth undoubtedly without a parallel in the history of American industry. No contributing branch of production has played a larger part in this rapid development than the foundry making automobile castings.

The increase in costs in the 20 year period has been great. As late as 1905 molders were paid 25 cents an hour and pig iron sold for $13 a ton. Today molders receive 90 cents an hour and pig iron costs $26 a ton. How can the manufacturer spend millions on sales promotion to sell an improved automobile for 50 per cent of the selling price in 1905, in light of the many increases in the costs of production? Undoubtedly the answer is found in the increase in the percentage of good castings produced. This saving is brought about by better control, changes in design, such as casting the crankcase and each of the cylinders as a unit instead of separately as previously was the custom and by replacing manpower with highly efficient machinery.

A few years ago the foundry superintendent was in charge of an industry entering a new field, an organization with no special training in the new work and with no adopted plan of operation. Today the foundry superintendent is a well trained executive and is fortified with an organization of specialists. He has a concise system of costs and production always at his finger tips through charts and prepared data.

In the early days of the automobile industry materials for the foundry were bought on general and often ambiguous terms. Often it was necessary to handle the material several times by hand before it reached the foundry. Grading often was done by visual observation, pig iron for example being broken and graded by fracture and piled for future use. The coremaker mixed his own sand, hand rammed the corebox and carried the cores to a poorly constructed oven, where, if the fire tender was alert, the cores might be baked evenly. After baking, the cores were cleaned more or less and stored in a haphazard manner, not much attention being paid to breakage or the needs of the foundry. The molders often came to work before daybreak. The foundries were dark, with poor artificial illumination and were poorly ventilated. The molders first saw that cores were on hand, doing a certain amount of inspecting and cleaning. Before starting to make the molds, he had to cut and prepare the sand and the sand was shoveled into the molds and hand rammed. He then set the cores piecemeal, using some judgment and a lot of guesswork, and carried the finished mold to the floor to await pouring.

Cupola practice was on practically the same level. After the materials to


Good Castings – 46.29% – (851,000) lbs.
Returns 4.27%
368,400 lbs. Scrap 9.21%
450,000 lbs. Pig Beds 11.25%
240,000 lbs. Loss in Melt 6.00%
Gates and Sprues 27.25%
1,090,000 lbs.

Results of a Melt of Gray Iron in 1905. Only 46.29 Per Cent of the Melt Resulted in Good Castings, 27.25 Per Cent Was Lost in Gates and Sprues, 6 Per Cent in Scrap While 4.27 Per Cent Was Returned to the Foundry From the Machine Shop

While Today Mechanical Equipment Speeds Production and Reduces Costs

Reduce Auto Costs

Superintendent Foundries
Wilson Foundry & Machine Co.

be charged had been taken to the charging deck by hand, what was considered a reasonable proportion of pig iron scrap and coke was charged in a small cupola. It was considered impossible to melt steel scrap to make semisteel except by the slow air furnace process. After the cupola was tapped the melted iron was carried in hand bulls, often to a considerable distance to the various floors of the plant to be poured. In the larger foundries, the molds were shaken out by the night gang. The sand then was cut and the foundry cleaned with the aid of many horse-drawn scrapers and carts. The castings were transported in hand trucks to the cleaning department and placed by hand on various benches where the cleaning and snagging operations were performed. The waste from the cleaning department was hauled to the dump in horse carts. After the castings were cleaned, they were hand trucked to the grinders, hand chippers and tumbling mills.

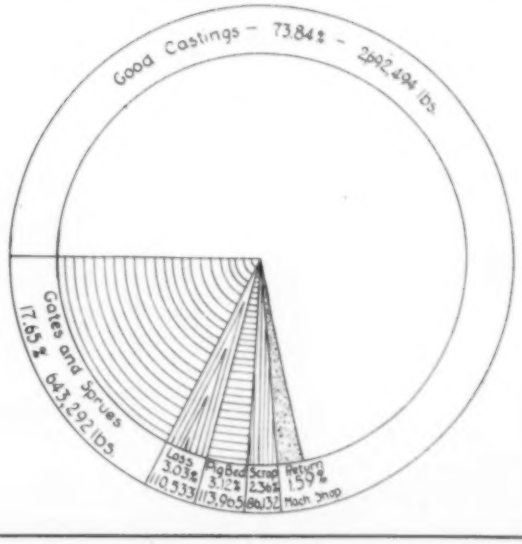
An entirely different situation is found in the foundry making automobile castings today. Under the system of foundry control now in operation, all materials are purchased under strict specifications. The purchasing department and the laboratory work hand-in-hand and market quotations are watched carefully, and the plant requirements considered far in advance. The material is subjected to laboratory tests upon arrival at the plant and before being unloaded, acceptance or rejection depending on the results of the tests. If accepted, the material is unloaded by overhead cranes of various types and stored according to analysis.

Core sand is mixed by mechanical methods and delivered to the coremaker on conveyors. The coremaker often may make hundreds of cores daily through the use of special machinery. The cores are placed on steel racks at his bench, the racks holding several hours work. When the racks are full, or when the cores are ready to be placed in the oven, an electric truck lifts the rack and deposits it in the oven. A proper system of drafts, recording pyrometer control and other improvements make it possible for the cores to be baked evenly. After baking, the rack is taken from the oven by the electric truck and placed near a continuous conveyor table, where by the use of machines and jigs, the cores are cleaned and the various assembly operations are completed, all under close inspection. The cores then are stored on racks awaiting removal to the foundry by the electric truck or monorail, at least 24 hour's requirements being handled at all times.

The molder starts work at a reasonable hour in a well-lighted and ventilated shop. Everything is ready for him and much of the work is done on machines. The flask is lifted onto the molding machine by a hoist. The sand is delivered to the flask through a conveyor system and a chute. A help-

(*Concluded on Page* 188)

Results of a Melt of Gray Iron in October, 1924. The Percentage of Good Castings Was 73.84, While Only 17.65 Per Cent Was Lost in Gates and Sprues, 3.03 Per Cent Was Lost in Melting, 3.12 Per Cent in Pig Beds, 2.35 Per Cent in Scrap and 1.59 Per Cent Was Returned to the Foundry From the Machine Shop



ARE POROUS CASTINGS *Caused by Gates and Risers?*

Release of Absorbed Gases During Pouring May Be Accomplished by Pouring From Bottom with no Feed Gates or Risers

By Howard Miller
General Electric Co.

INVESTIGATIONS undertaken in the laboratory from time to time to determine the cause of leaks in certain castings subjected to high gas pressure have led to the consideration of foundry practice under which these castings were made The conclusions reached were that the leaks, in the main, were due to trapped gas bubbles resulting from the release of adsorbed gases during cooling of the molten metal. The logical solution of this problem would appear to be in melting the metal under conditions which would keep the amount of gases taken up at a minimum. However, articles have appeared covering the pouring of castings without risers or shrink heads. These articles have lead the author to consider the subject of leaky castings in conjunction with adsorbed gases in the molten metal and particularly during the time and immediately after the molten metal is poured.

In the Oct. 15, 1922 issue of THE FOUNDRY, E. Ronceray, P. H. Bonvillain & E. Ronceray, Paris, France, presented a paper on the subject of pouring iron castings without the risers and feeding heads, both of which usually are made use of in foundry practice. Mr. Ronceray stated that he was not prepared to attempt an hypothesis explaining the apparent phenomenon that castings poured in this manner were found to be more sound than those poured in the usual way, but simply stated results of his own experiments and observations extending over a considerable period.

In the July 15, 1923 issue of THE FOUNDRY, Roy E. Paine published an article entitled "Feeding Heads Not Necessary." This article gives a number of examples of nonferrous castings made by the pressure system of pouring without feeding heads and risers. Mr. Paine also gave no explanation as to why castings poured in this manner should be more sound and free from porosity than those poured in the usual style of mold. It seems to be taken for granted in both of these articles that the porosity is due to shrinkage. Under certain conditions this is true in a measure but the author believes that more than shrinkage alone lies behind the trouble.

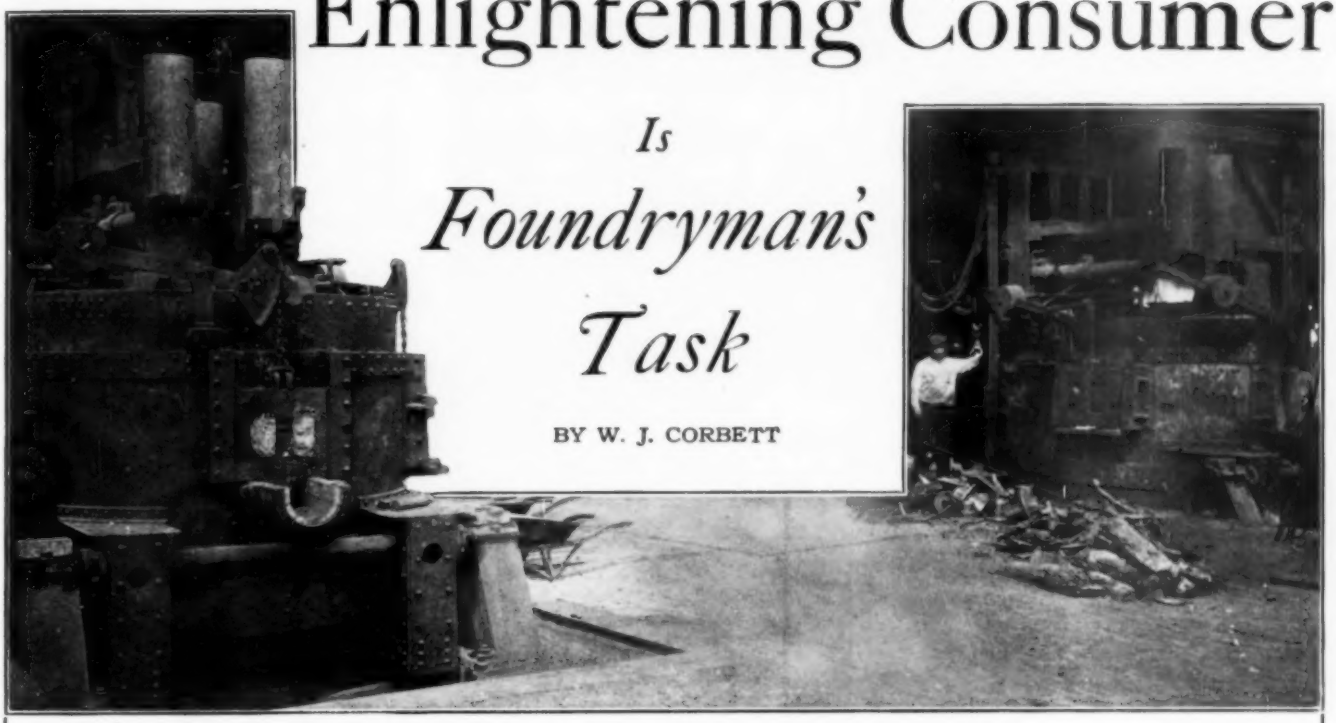
The porous condition often encountered in castings is due largely to the releasing of occluded gases taken up during the melting. The rough globular form of the holes responsible for this porous condition and the appearance of the inside of the holes are evidence of gas bubbles. Gases taken up or occluded during the melting period are released as the metal cools and freezes. The capacity of the molten metal to take up gases, generally speaking, increases with the temperature and the reverse is true as the temperature drops. There is also a point of saturation as well as a degree of saturation. The amount of occluded gases in the molten metal partially is dependent upon the melting practice, but it is safe to say that all molten metal contains occluded gases and in the average foundry practice this amount may be quite high. It also is more than likely that the metal will be poured on the hot side, that is it will be hotter than necessary, which means more adsorbed gas. In pouring the mold, especially if it is one of differing sections, there is a difference in the rate of cooling depending on the section and the method of pouring.

Consider the pouring of a ring, say 18 inches in diameter, 12 inches high and ½-inch thick with a ring around the top 1½-inch square section. In ordinary foundry practice this probably would be poured with the usual pouring or feed gate and risers for the purpose of feeding the shrink of the heavy ring from these risers. The molten metal, at whatever the pouring temperature may be, is poured into a feed gate and immediately starts to rise in the mold, the level coming up fairly uniformly. However, the rise of the metal is by top addition, that is, the first metal in, falls to the bottom of the mold and there cools and finally freezes. Some washing or running takes place until a level is established, but this will be disregarded now. It is safe to say the molten metal has been gassed to some extent, at least to the saturation point at some temperature above its freezing point. Therefore, the first metal in the mold during the cooling and freezing gives up these gases which rise as long as the viscosity of the molten metal will permit. Where they come in contact with the hotter metal which is being added, the gases are taken up and again released with subsequent cooling. This action is progressive until at the time the mold has been filled, the last metal poured, being still hot, is brought to a saturation point of adsorbed gases. This results in a concentration of gases at those points which remain hot and fluid longest, this section usually being the center of a heavy section. This section has formed around a rather effective protecting skin of metal which has frozen on contact with the mold. As this section cools the gases are released and due to gravity tend to rise. They rise until the increased viscosity, due to cooling and freezing, arrests their progress and they are trapped in the form of bubbles.

Now consider this same mold poured from a single horn gate connected with the bottom of the ring and having sufficient height to create some static pressure. The same metal as previously used now is poured into this mold, but instead of the metal being added to the top, it is added at the bottom and the metal in the mold rises because of the unbalanced condition of the two columns. As the metal rises in the mold, it becomes cooler and the absorbed gases are released, float to the top and pass out through the walls of the mold. The casting freezes from the top down, and the cooler metal at the top having been relieved of gases to a certain degree freezes with a less tendency toward concentration of gases and the result is a better casting. In a measure this may explain the fact that castings, which develop porous sections, when poured in the usual way are found to be less liable to this condition when poured from the bottom with no feed gate or risers.

The subject of adsorption of gases by molten metals recently has been receiving considerable attention. Although it has been recognized for a long while that this phenomenon had to be contended with, it is probable that many foundry men have not given it due consideration in connection with porous castings.

Enlightening Consumer Is Foundryman's Task



BY W. J. CORBETT

EFFORTS of those directly or indirectly concerned with the making of castings must be co-ordinated completely before many problems facing the foundry industry are solved. The degree of responsibility resting on the foundryman, the designer of castings, the patternmaker and the customer is not definite, each feeling that the blame for an inferior product rests with the other party. However, if the foundryman expects to sell castings and be assured that the customer will be satisfied, he must take the lead in educating the customer, designer and patternmaker in the fundamentals so essential to successful foundry practice. Since the casting is designed by the customer and the pattern is furnished by him in many cases, the foundryman must sell the idea of correct design and practical patterns. The author, who is industrial engineer Electric Steel Founders Research Group, Chicago, has pointed out what the foundryman should know in selling castings and has touched on the efforts that have been made toward eliminating poor practices in the design of castings, the ways in which the patternmaker may contribute to the successful manufacture of the commodity, the paramount need of cost-keeping systems and methods of figuring the selling price of castings which will yield a profit, the ways in which the foundryman may be of greater service to the customer and the duties that fall on the buyer and seller.

MUCH improvement has been made in quality and methods of producing steel castings and there is no reason to doubt that advancement along these lines will continue. Steel foundrymen have been particularly zealous in the study of manufacturing problems. It is maintained by many who have considered the industry's development in all branches, however, that progress has been relatively slow in those phases that relate to scientific and economic merchandising.

The problem of distribution is recognized by foundrymen as being extremely important. It is largely a problem of education, thus foundrymen should endeavor to enlighten consumers concerning the manufacture of castings. This would enable both users and makers of steel castings to make many adjustments in their customs, particularly in the elimination of wasteful practices.

Responsibility for enlightening consumers of castings about foundry practice rests with those who make and sell the castings, consequently they should use every opportunity to explain to the users of their products the facts which will further friendly relations. The result would be castings produced with a minimum of waste and greater satisfaction to the users. Some of the points that might profitably be explained to consumers are suggested here.

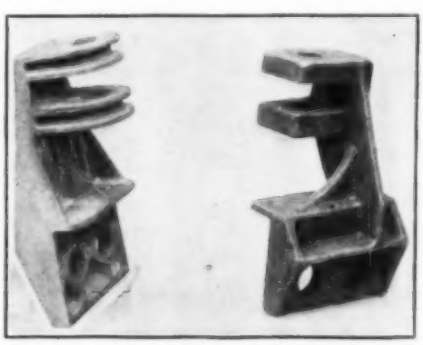


FIG. 1—RIGHT—CASTING REQUIRING RIGHT AND LEFT HAND PART—LEFT—REDESIGNED TO SERVE AS BOTH PARTS

Designers of castings and foundrymen should co-operate closely. Sometimes, castings have designs that are impractical from a foundry standpoint, but these designs often can be altered without affecting the utility of the castings. The modified designs would cause no difficulties in making the castings and the purchaser would receive better castings than he might have obtained from the original design. This is particularly true in steel castings, which have a greater shrinkage than iron during the cooling of the metal from a liquid to a solid. Therefore, it is desirable that steel castings be designed in such a manner that shrinkage of the metal can be provided for by the use of suitable feeding heads and pouring gates, thereby obtaining castings having solid sections of metal.

Improper designs frequently are the cause of cracks from the unequal rate of cooling of the metal in adjacent parts of castings, in spite of the foundryman's efforts to prevent these defects by using chills, brackets, fillets, and tie-bars; and

FIG. 2—MAIN BAY OF MOLDING FLOOR IN A STEEL CASTING FOUNDRY

by giving proper consideration to the location of gates and risers, the hardness of molds and cores, and the rate of cooling of the casting after it is poured. Many difficulties in making satisfactory castings could be overcome if designing engineers would confer with the foundryman when new castings designs are being made.

Much Loss Is Avoidable

Troubles caused by castings that develop defects in the machine shop, and the consequent delays in the customer's shop due to this, could be minimized by co-operation in design. Loss of the customer's goodwill from defective material, also could be reduced by proper casting design. Rejection in the customer's shop of castings that have proved defective due to faulty design, incurs an added expense to the foundry in replacing the castings. This expense is absorbed in the foundry's production cost, and consequently is reflected in the price of its product. Since the cost to manufacture governs the price of castings, any factor affecting the former affects the latter.

No definite rules that will be applicable to the designing of all castings can be formulated, because each design presents a separate problem. However, due regard must be given to the thickness of metal sections, use of fillets, elimination of sharp corners, intersections of members having different thicknesses, recesses to be cored, and other important details. Foundrymen often can recommend slight changes in design which will permit more rapid production of the castings, and thereby reduced costs. Consultation with foundry representatives enables users of castings to obtain the benefits of the foundrymen's experience with these important factors pertaining to design.

In the past, individual foundries have encouraged their customers to show the weights of castings on the drawings but only recently has any attempt been made to secure the concerted action of all foundries in requesting consumers to follow this practice. Designers and consumers of castings render a service to themselves and to foundrymen when they show on their drawings the weights of castings to be purchased. The correct weight of a casting must be obtained to enable the foundry to calculate the cost of making it, and not merely for the purpose of referring to a schedule of costs or prices classified according to weight. Schedules of this kind are erratic and do not represent the cost of making any particular casting in a jobbing foundry. When the casting has been made on a previous order, its actual weight can be obtained from production records; but when this information is not available, the weight must be obtained from the drawing.

Considerable delay and expense are

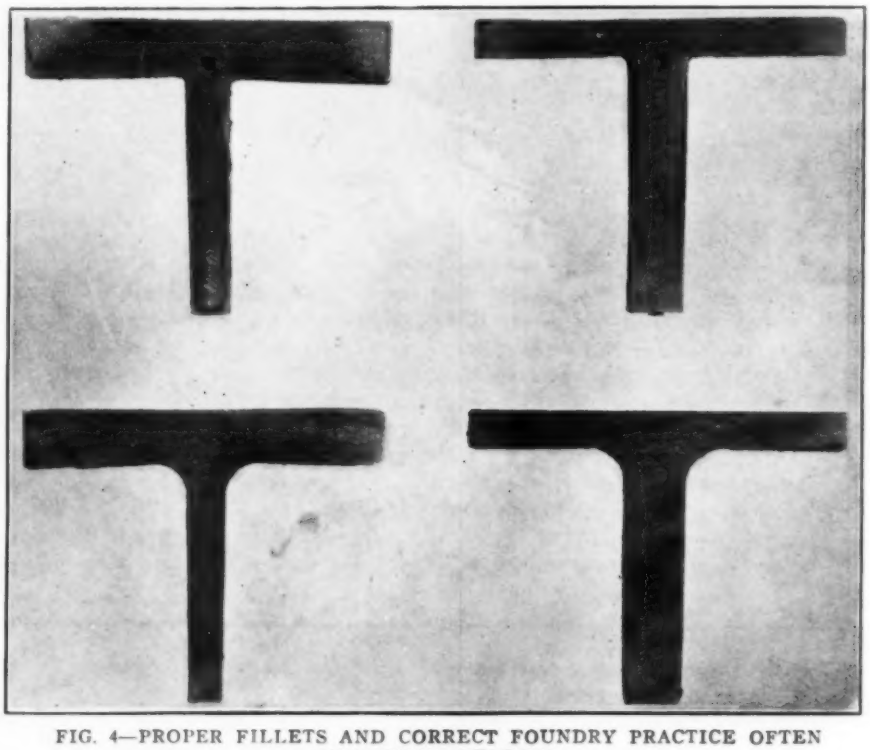


FIG. 4—PROPER FILLETS AND CORRECT FOUNDRY PRACTICE OFTEN OVERCOME DEFECTS

FIG. 3—COREBOXES SHOULD BE PROVIDED FOR EACH JOB WITH CORES. CORE ROOM IN A STEEL FOUNDRY

entailed when it is necessary to calculate weights of castings from drawings. It is not uncommon for a foundry to receive a large number of drawings with inquiries from consumers of castings, and when weights are not specified, much time is lost in waiting for the information to be calculated. Calculating weights require great care and accuracy if reliable costs are to be obtained, and it requires considerable time. It should not be done in a haphazard manner because a small variation in the calculated weight from the actual weight, materially affects the cost of castings.

When a casting is designed, the usual practice is for the engineer or draftsman to estimate its weight. This, of course, is necessary in those instances where it is desired to secure the minimum weight with the maximum strength. It would be desirable for designing engineers to make permanent records of their estimated weights by showing them on the drawings of their castings.

The foundryman should secure from customers some facts about the uses for which castings are purchased. This would enable him to regulate his manufacturing operations so that the castings will conform with the customer's requirements. For example, if a certain part of a casting must fit closely with another part of the apparatus or mechanism in which it is used, the foundryman will pay particular attention to this, and plan his operations so that the customer will have no difficulty with the casting in the assembly operation. In such cases, gages might be used on the casting by the foundry inspectors, in order to be certain there are no imperfections to prevent the perfect fitting of assembled parts. Foundrymen sometimes can suggest certain economical changes in a customer's plans when informed concerning the use of a casting in service.

FIG. 5—SECTION OF A CLEANING ROOM IN A STEEL FOUNDRY

Customs of Steel Foundry Industry

1. *Suitable pattern equipment for economical molding should be furnished by the customer.*
2. *The foundry is not responsible for the correctness of pattern equipment to blue print, except when such equipment is made for the customer under the supervision of the foundry.*
3. *Repairs on pattern equipment should be paid for by the customer, except when occasioned by carelessness on the part of the foundry.*
4. *Patterns must have the distinctive colors adopted by the joint committee on pattern standardization, which are the following: Surfaces to be left unfinished should be painted black. Surfaces to be machined should be painted red. Seats of and for loose pieces are to be red stripes on a yellow background. Coreprints and seats for loose coreprints are to be painted yellow. Stop-offs are to be indicated by black diagonal strips on a yellow base.*
5. *All patterns, core boxes, and loose pieces thereof must be properly numbered for identification.*
6. *All transportation charges on pattern equipment to and from the foundry must be paid by the customer.*
7. *The foundry does not carry insurance on customers' pattern equipment.*
8. *Free replacement is made of defective castings if reported and returned to the foundry within a reasonable time.*
9. *The foundry is not responsible for any expense on defective castings incurred by the customer.*
10. *The customer is charged with the cost of molds and cores discarded by the foundry due to change in patterns or core boxes*

Making The Patterns

Pattern equipment is of vital importance to makers and users of castings, for it has the greatest influence on the cost of production. Hence, it is essential for all foundries to enlighten consumers as to the advantages of providing suitable patterns and core boxes. Many foundrymen have been lax in this respect. In their eagerness to procure orders for castings, they have neglected to insist upon being furnished with proper working tools in the form of pattern equipment. Frequently equipment provided does not permit manufacture in the most economical manner.

The foundry is in business only to secure a fair return on its capital, and if this cannot be secured from castings made from certain patterns, greater

FIG. 6—EFFORTS SPENT IN CLEANING CASTINGS PROPERLY MAY BRING ADDITIONAL ORDERS

profits must be secured from castings made from other patterns.

Patterns should have a rigid construction. A poorly constructed pattern that has a low initial cost often proves most expensive in the end, due to the difficulty in making good castings from it and to the necessity for frequent repairs. When castings are made from a pattern at more or less frequent intervals, the total number of castings during a period of time justifies making the pattern from a hard, durable material, such as hardwood or aluminum. This kind of pattern equipment is economical to the customer. The cost of maintenance for well-constructed pattern equipment is less than that for poor equipment, and this expense, is paid by the customer.

A cheaply constructed pattern is expensive to the customer, because in addition to the increased cost of making castings from it, the castings produced will not give the same degree of satisfaction that would be obtained from those made from good equipment. Consumers of steel castings have frequently complained to foundries about the castings they receive, when the fault was poor pattern equipment.

Average patternmakers employed by casting consumers are not expected to have as complete knowledge of up-to-date foundry practice as is possessed by the foundryman. Therefore, if casting consumers desire good castings, foundrymen should encourage consultations in regard to the construction of pattern equipment. The plan best for the foundry as well as for the customer, is for the foundry to make the pattern at the customer's expense. When this is not feasible, the pattern should be constructed in accordance with the recommendations from the foundry which is to use it.

No fixed rules can be given for details of pattern construction that will apply to all designs. Nevertheless, there are some things to which consideration must be given in all cases. For example: a pattern must be of such design that a mold made from it will provide adequately for the pouring of the casting, and for the feeding of it while shrinkage of the steel takes place during its solidification. This relates to the use of proper heads and gates which are vital in the production of castings of solid metal sections. Provision for such matters should be left to the foundryman.

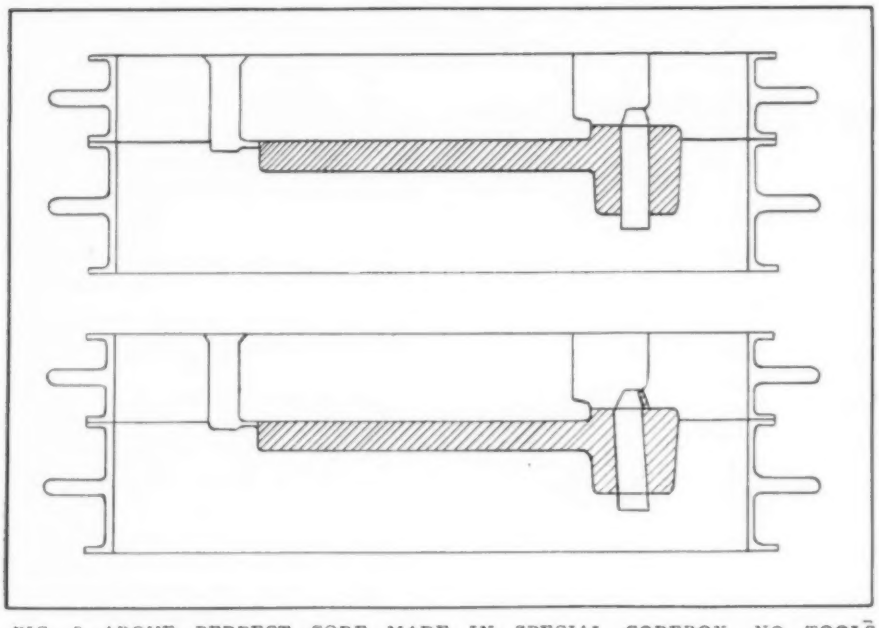


FIG. 7—ABOVE—PERFECT CORE MADE IN SPECIAL COREBOX, NO TOOLS BEING REQUIRED—BELOW—STOCK CORES CAUSE UNNECESSARY LABOR AND TOOLS AND MAY RESULT IN SHIFTED CORES AND DEFECTIVE CASTINGS

Provision of proper fillets at the intersections of the walls of a steel casting often is neglected. Patternmakers either fail to put them on the patterns or use fillets of improper sizes. Proper fillets are necessary on steel castings in order that objectionable defects can be prevented; they must not be too small nor too large. The general design of the casting, the thickness of the adjoining walls of metal, and the foundryman's experience should determine the proper size of fillet to be used. Square inside corners on a casting should be avoided.

Pattern equipment sometimes is received for making castings of more than one design by changing loose pieces on the pattern or core boxes. This is confusing to foundrymen, and requires careful supervision to prevent errors. Foundrymen should advise customers providing such pattern equipment when the cost of producing castings of more than one design from one pattern with changeable parts may be greater than the cost of producing them from separate complete patterns for each design. Although there is a saving in the cost of pattern equipment by using adjustable patterns, the customer can be expected to pay for any extra cost of making castings.

It is a common practice, and one to be discouraged, for patternmakers to refrain from making core boxes for round cores, in the belief that the foundry is prepared to furnish such cores from stock. Stock cores are undesirable from almost every standpoint. The expense saved by not making a core box for each core generally is more than offset by the increased cost to the foundry in making such round stock cores to size so that they will fit the mold, and by the extra cost of cleaning the castings, due to the necessity for removing fins or lumps of metal surrounding holes in the castings caused by the cores fitting the molds improperly. There is no economy in saving one cent by using a stock core and then spending two cents extra for cleaning the casting. When stock cores are used, there is greater likelihood of castings being defective due to the shifting of the cores in the mold and to the sand from the mold or core becoming entrapped in the steel. These details increase the cost of making the castings and lessen the possibilities for making perfect castings at any cost.

Some patternmakers fail to provide coreprints on the cope side of patterns, merely indicating by painting the pattern that the cores cut through the casting at certain points. This is another practice to be discouraged. The cost of cleaning a casting almost invariably is increased when coreprints are not used on the cope side of the pattern, because it becomes necessary to remove from the casting, resulting fins that surround or completely cover the cores on the cope side. Furthermore, the core is much more liable to be shifted from its proper position when there is no core-print on the cope side.

Importance of the construction of core boxes often is disregarded. Core boxes are just as important as the pattern used for making the molds. Many castings are defective because the core boxes have become worn or their parts have become loose or warped out of shape. When a number of cores must be made from one core box during a period of time, it is desirable that the box be made of hardwood or aluminum, the latter being preferable. This is true especially in the case of castings of small and medium sizes, since great precision is required in making small castings. Slight variations in sizes of cores, caused by poorly constructed core boxes, make it difficult to produce satisfactory castings. If hardwood instead of aluminum

is used for making a core box, the joint of the box where the sand is scraped off by the coremaker should be faced with sheet metal. This prevents wearing and facilitates making cores true to size.

Patterns should be painted in accordance with the standard practice recently adopted by the Joint Committee on Pattern Standardization, consisting of representatives from the American Foundrymen's association, American Society for Testing Materials, American Society of Mechanical Engineers, Foundry Equipment Manufacturers' association, National Association of Pattern Manufacturers, National Association of Purchasing Agents, Steel Founders' Society of America and American Malleable Castings association. The committee's standard practice for painting patterns is as follows:

"Surfaces to be left unfinished should be painted black. Surfaces to be machined should be painted red. Seats of and for loose pieces are to be red stripes on a yellow background. Core prints and seats for loose core prints are to be painted yellow. Stopoffs are to be indicated by black diagonal stripes on a yellow base."

Foundrymen should require consumers of castings to furnish them with the number of duplicate patterns necessary for economical and rapid production of castings. It is not uncommon for a foundry to receive a single pattern to be used for making a quantity of castings. The foundry then finds it necessary to request the customer to send additional patterns, because the price quoted for the castings was based on the cost of making them from adequate pattern equipment required for economical production. When only a single pattern or one not mounted or suitable for mounting on a matchboard or follow-board for machine molding is provided, the cost of production is much higher than was estimated on the basis of suitable pattern equipment. The increase in price that the foundry would expect to receive in such a case probably would exceed the cost of the additional patterns requested from the customer.

Cost of Castings

The cost of making a casting depends largely on its design and size and not entirely on its weight, because the cost of the steel in the casting is not the major item. Labor and overhead have the greatest influence on the total expense. These two factors are affected mainly by the design of the casting. While most foundrymen realize this fact, apparently many of them have not put it into practice by explaining to consumers the disadvantages and unsoundness of price schedules subdivided according to weights of castings. Schedules for miscellaneous castings are decidedly unscientific and erratic and have no justification. They are unsatisfactory for consumers as well as for foundries because they cannot be established in any manner that is equitable to either.

The time is not far distant when steel foundrymen and the purchasers of their castings will dispense with the use of weight schedules. Castings then will be merchandised, as many of them now are by progressive foundries, on the basis of the cost of production of castings from each pattern; that is, there will be a separate price for each kind of casting, based on the cost of making it, plus a fair profit commensurate with the capital risk in the foundry business. It is only logical and in accordance with good business methods that this should be the condition. This plan will tend toward stability, economy and intelligent conduct of business.

Every foundry should have and make constant use of a method for calculating the costs of individual castings. It is essential that this be based on the principles of cost-finding in use by the other members of the industry in order to insure uniformity in cost-finding methods. A method for finding the costs of individual castings was developed by the writer and presented at the Milwaukee convention of the American Foundrymen's association last October.

Orders for Small Quantities

Orders for small quantities of castings are more costly to the foundry than orders for larger quantities, this being especially true for small castings. If a foundry were to investigate the cost of handling an order for castings, it would find certain expenses such as those for clerks who enter the requisition and issue works orders, for pattern delivery and examination and often for much of the selling effort, to be the same for an order for one casting as it is for an order for one thousand castings. Assuming that the foundry's cost of entering and preparing an order for execution is $2.50, it is obvious that this amount must be added to the expense of filling it.

Other expenses besides these are chargable to an order regardless of its size and tend to make orders for small quantities costly. If the foundry has some difficulty in making the castings when production is begun, a few scrapped castings on an order for a small quantity increases the total cost materially. For instance, five defective castings on an order for ten castings represents a loss of 50 per cent, while five defective castings on an order for one hundred castings from the same pattern represents a loss of only 5 per cent. The larger order provides an opportunity for the foundry to overcome the difficulties by gaining experience, and to reduce the loss due to defective castings which, of course, is absorbed in the cost of production.

Delivery troubles are more common with orders for just a few castings than for larger quantities and are annoying to both the foundry and its customers. Frequently, one casting on an order for five or ten castings cannot be found in the shop and has to be made again.

Metal Strengthens Plaster Patterns

(*Concluded from Page* 177)

direct attention to a few don'ts which must be observed in the process of applying a metal coating to plaster patterns. Don't forget to insert small pieces of copper tubing to form draw and rapping holes in the pattern. Don't forget to dry the pattern thoroughly before it is placed in the wax bath. Moisture in the plaster will cause the hot wax to spatter and fly and may burn the operator. Don't fail to finish the surface perfectly before it is plated. If possible, the metallic coating should not be fingered before the pattern is placed in the electrochemical bath. In the event that a patternmaker is not familiar with a suitable metallic coating or does not know how it may be applied, he can send the wax soaked pattern to the electrotyper's establishment. The plater will prepare the pattern to receive its metallic deposit.

A plated pattern cannot be compared to iron, but in the main it is equal to a white metal pattern. Dents and bruises readily may be filled with solder and filed smooth. A typical pattern for a motor head has been used to make 2800 castings and with the exception of a few minor repairs to dents caused by carelessness in the pattern storage, the pattern is as good as new.

Any person dealing with patterns readily will appreciate the extent to which a pattern is strengthened by enclosing it in a copper sheath from 0.010 to 0.015 of an inch in thickness. All thin wood master patterns should be treated in this manner to prevent them from breaking or warping.

Builds Pattern Vault

The Newman Foundry Co., Kendallville, Ind., is completing a new pattern vault 30 x 65 feet. The new vault is fireproof and adjoins the pattern shop.

The Ann Arbor Foundry Co., Ann Arbor, Mich., has started manufacturing abrasive materials such as balls, stars, etc. This company was organized in 1920 and in four years has tripled its capacity.

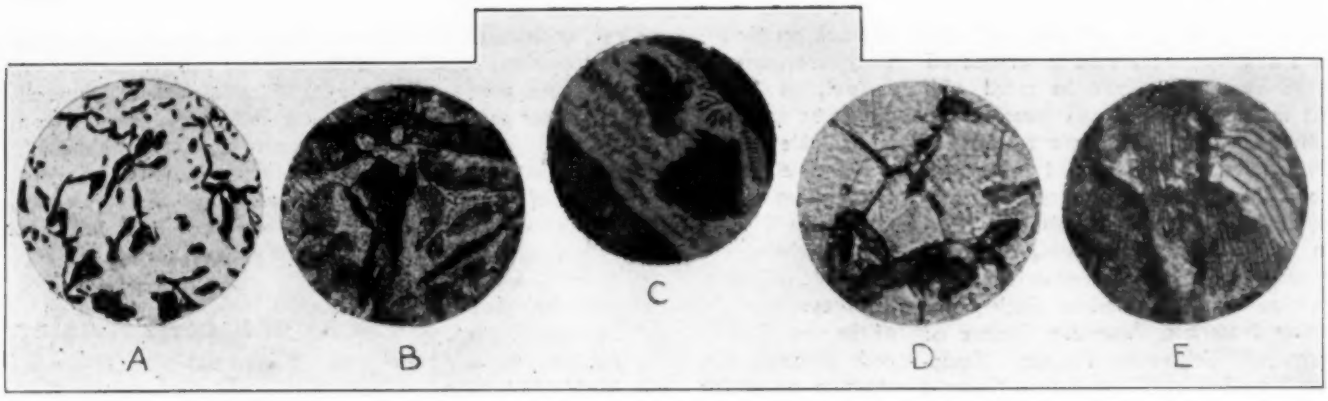


Fig. 1—Structures found in gray cast iron: A, Graphite. The black flakes represent graphitic carbon—Unetched—x 50 dia. B, Pearlite—The fine lined structure is pearlite—picric acid—x 500 dia. C, Steadite—The light gray area is steadite—picric acid—x 500 dia. D, Ferrite—Light Areas bounded by thin dark lines are ferrite crystals—picric acid—x 500 dia. E.—Shows a combined general structure—picric acid—x—50 dia.

Controlling Gray Iron Qualities

By James Ward

STRENGTH, grain and machinability of cast iron and semisteel are determined largely by the elements contained and by the cooling rate. Good molding practice, proper design, suitable sand and correct cupola operation insure sound castings. However, if such castings are weak, brittle or too hard, they will give poor service notwithstanding their freedom from shrinkage, blowholes and scabs.

The four elements most commonly considered in foundry irons are silicon, sulphur, manganese and phosphorus. Within recent years more attention is being given to the action of total carbon. Research has shown that it is the condition of the carbon in the iron that controls the physical properties and the condition of the carbon is determined largely by its amount, the per cent silicon, and the cooling rate.

Elements

Silicon—Acting largely through its effect on the carbon ratios.

Increases	Decreases
	Combined carbon
Graphite	Shrinkage
Open grain	Hardness
Softness	Chill
Fluidity	Strength

Silicon probably occurs throughout the iron in solid solution as silicon ferrite. Therefore, it cannot be seen under the microscope. In ordinary foundry practice, silicon is best introduced as high silicon pig, although additions in the form of ferrosilicon have given satisfactory results. Heavy castings would often be improved by lowering the silicon content. Higher silicon irons should be used in mixture for small castings as the high silicon will increase fluidity and soften the metal.

Total carbon occurs in two forms, graphitic carbon, and combined or pearlitic carbon. These two forms will be considered separately to avoid confusion.

Graphitic carbon is found in cast iron and semisteel in the form of weak, wormlike flakes. It has been shown that the fracture follows along these flakes. The amount and arrangement of this weakening element are matters of the greatest practical importance. During the last few years there have been a number of papers printed in THE FOUNDRY and other publications giving results of various researches upon the influence of graphite. Most of these articles may be summarized briefly as follows:

The graphite flakes are composed largely of true graphitic carbon, the same in crystal makeup for example as ceylon graphite. This carbon is contained in a network of pure iron. Most of the graphite is in the form of flakes as seen in photomicrographs. A small amount of graphite, or perhaps more accurately free carbon, is contained in solid solution in the metal. When first formed, the flakes follow the structure of the original cementite. On slow cooling, they rearrange themselves in long coarse flakes. There is a close relation between the amount and arrangement of the graphite and the strength of the iron. The amount and arrangement may be controlled by adjustment of total carbon, silicon, and the rate of cooling.

While there are exceptions, the majority of strong cupola irons will be found to contain about 2.5 per cent graphite, and the weaker irons over 3.0 per cent graphite.

Combined carbon in gray iron and semisteels is found in the pearlitic form, the thumb print appearing structure found in gray iron and semisteel. Up to 0.70-1.00 per cent combined carbon increases strength with an increase in shrinkage and hardness. Beyond this point we find the mottled and white irons. These are intensely hard and quite brittle, and, therefore, are adapted only to a few special uses. *A* and *B*, Fig. 1 shows clearly the effects of changes in combined carbon content.

Combined carbon is increased by quick cooling in thin sections, low total carbon, chromium, high manganese and sulphur. Combined carbon is decreased by high silicon and slow cooling in heavy sections.

Sulphur has long been a pariah among the elements. Parts of its bad reputa-

Babel of Tongues

IT OFTEN has been asserted by practical foundrymen that the average chemist and metallurgist when speaking of research work in metallography are apt to use scientic terms which are more or less confusing. This detracts from the value of their work.

The author of this article evidently wished to avoid such a fault. He has simplified such scientific terms by his use and description of them.

The American Society for Testing Materials now is drawing tentative definitions covering terms relating to metallography and is standardizing the preparation of micrographs and their magnifications. This will make the results obtained by chemists and metallurgists more valuable and intelligible to the foundryman.

tion is undeserved. For a time there was a general belief that sulphur formed a weak intercrystalline network between the iron grains. This condition was stated to give weak iron subject to all sorts of defects. Recent research has shown that this is not the case. Under most conditions the sulphur is contained in little globules of manganese sulphide. It is now supposed that sulphur tends to give a closer grained iron. Many foundries are making high grade iron with twice the amount of sulphur thought permissible ten years ago.

Sulphur has also been considered the principal cause of blowholes. The reason for this belief is not hard to find. The side of the casting containing the blowholes usually is the highest in sulphur—but gases generated in pouring the mold and manganese sulphide both seek the top of the casting. Impermeable sand and improperly prepared molds cause blowholes that cannot be blamed on higher sulphur. Sulphur does diminish fluidity, thereby entrapping gases. Also it may react with excess gas dissolved in the iron to form free sulphur oxide. High sulphur pig iron usually is an indication of improper furnace conditions. The solution to the sulphur problem is scientific practice and research work.

Manganese in the amounts desirable in gray iron and semisteel practice performs the following functions:

(1) It acts as a deoxidizer. There always is a greater relative amount of manganese than of iron or even silicon lost in the slag. The loss usually amounts to about 20 per cent manganese.

Manganese neutralizes the sulphur, uniting with it to form manganese sulphide. It apparently takes only about three times as much manganese as sulphur to cause complete formation of manganese sulphide. This sulphide may be beneficial.

In special irons of high manganese content this element may increase the combined carbon, promote solution of carbon from the coke and increase shrinkage.

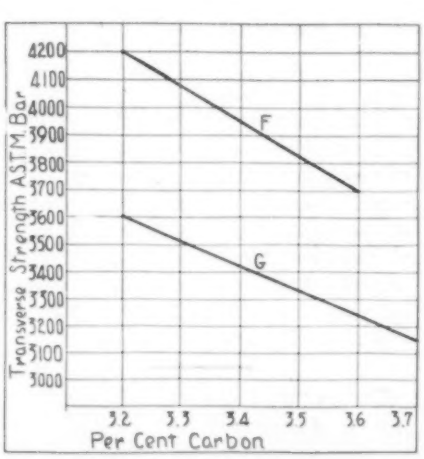


FIG. 2—EFFECT OF CARBON CHANGE ON THE TRANSVERSE STRENGTH OF CAST IRON

Phosphorus occurs in gray iron and semisteel as the hard brittle constituent known as steadite. It increases the abrasive hardness, as the steadite acts as gritty particles in the metal. Phosphorus has little effect on the brinell hardness of most irons and has no marked effect on the strength. Its effect on fluidity, speaking of irons under 1.00 per cent phosphorus, is not as great as some suppose. Irons containing 0.20 per cent phosphorus pour well if melted at the maximum temperature.

A foundryman with the aid of chemical analysis can control the elements fairly closely. In ordinary foundry practice, the cooling rate is almost synonomous with section size. Cooling rate has a powerful influence and its effects can be modified only in part by changes in analysis. *Many a casting is spoiled in the drawing room.*

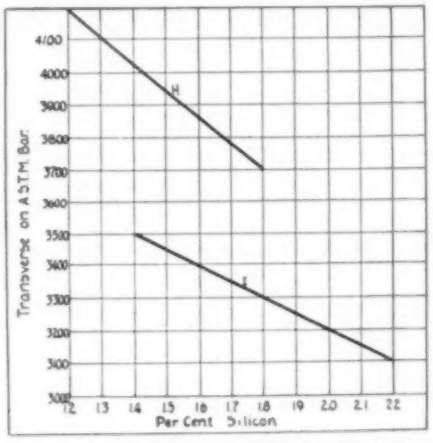


FIG. 3—EFFECT OF SILICON CHANGE ON THE TRANSVERSE STRENGTH OF CAST IRON

Cast iron follows certain natural laws, which laws are immutable. Just as in jurisprudence the shrewd lawyer may avail himself of some technicality and avoid the real issue, so the foundryman with his art and the metallurgist with his knowledge can, within limits, by various subterfuges make fairly good castings from poor designs. However, in many cases the evil should be remedied at its source. It seems almost a waste of time to point out that heavy sections cool more slowly than light ones, and that the outside cools more rapidly than the inside, but many shrinkage holes, cracked castings and open grained parts bear eloquent testimony that common sense does not always predominate.

The accompanying illustrations show a few pertinent examples and the curves indicate the approximate differences to be expected due to various percentages of carbon and silicon in cast iron.

In Fig. 1, *A* shows a graphite structure. The black flakes represent graphitic carbon, unetched x 50 diam. Pearlite is shown in *B*. The fine line structure is pearlite etched with picric acid x 500 diameter. In Fig. 1, *C* is steadite. The light gray area with the small dark dots is steadite, etched with picric acid x 500 diameter. In the same figure, *D* is ferrite. The light areas bounded by the dark lines are ferrite crystals etched with picric acid x 100 diameter. The general structure at *E* shows black flakes of graphite surrounded by light areas of ferrite, carbon free, gray, thumb-print structure of pearlite containing combined carbon and light honeycombed crystals of steadite containing phosphorus etched with picric acid x 50 diam.

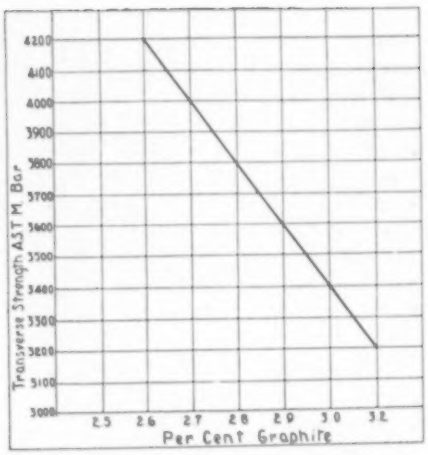


FIG. 4—EFFECT OF PER CENT GRAPHITE CHANGE ON TRANSVERSE STRENGTH ON CAST IRON

In Fig. 2, *F*, represents semisteel with an approximate silicon content of 1.40 per cent. Line *G* represents a medium cast iron, silicon 1.75 per cent. The other metalloids are similar in the two irons, running approximately, sulphur 0.12, phosphorus 0.35 and manganese 0.60 per cent.

Changes in the carbon percentage are as important as changes in the per cent of silicon. The highest test irons usually are low in carbon. A minimum carbon content with low silicon will cause chilling in small sections. The effect of carbon and silicon must be taken into account jointly when making up iron mixtures, as silicon aids fluidity thus enabling the carbon to separate out in its graphitic form prior to the set of the metal.

In Fig. 3, line *H* represents a semisteel with a total carbon content ranging from 3.30 to 3.40 per cent. Line *I* is a soft machinery iron, no steel being used in the iron mixture, with a total carbon ranging from 3.50 to 3.60 per cent. The sulphur, phosphorus, and manganese content in the two irons being approximately the same, sulphur 0.12 phosphorus 0.35 and manganese 0.60 per cent.

Fig. 3 gives the approximate relation-

ship of per cent silicon to transverse strength on the arbitration bar. Decrease in strength with increase in section size is more marked in the higher silicon irons. Decrease in section size affects increase in strength until the iron begins to chill. From this point, varying according to the iron and condition of pouring, the strength decreases. Decrease in carbon increases strength. In the case of carbons ranging from 3.00 to 3.10 per cent, the silicon apparently has less effect in physical change.

Fig. 4 shows the approximate relationship of the per cent graphite to transverse strength as determined by a number of tests. Providing the combined carbon does not greatly exceed 1.0 per cent, the strength will continue to increase until the graphitic carbon reaches a minimum or 0.0 per cent at which point the strength should approximate that of a high-carbon, cast steel. The limit of the cupola process are such that it is difficult to produce a gray iron with graphite under 2.5 per cent. The size and segregation of graphite are as important as the amount of graphite.

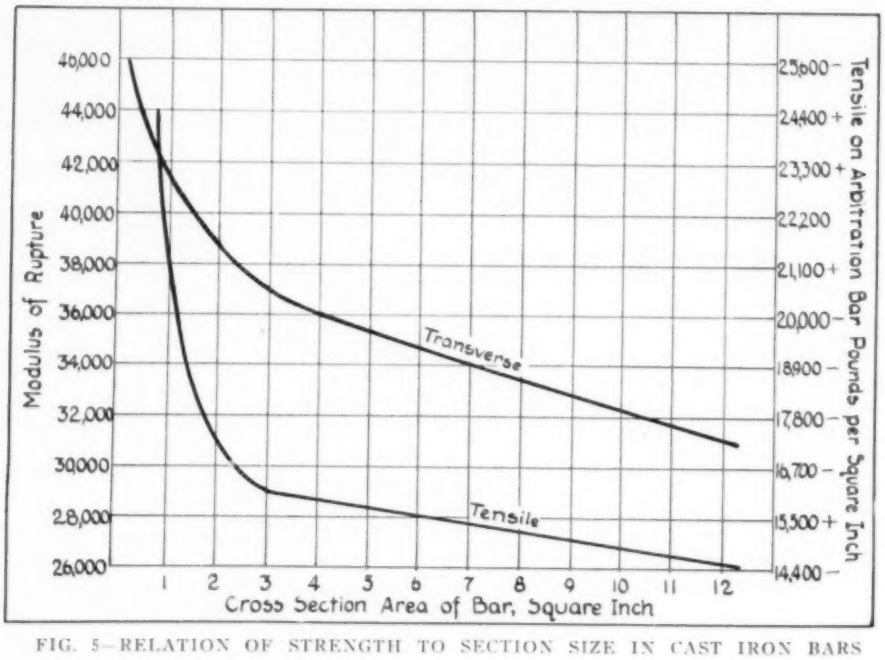


FIG. 5—RELATION OF STRENGTH TO SECTION SIZE IN CAST IRON BARS

The relation of strength to section size is shown in Fig. 5. The transverse tests are on bars of iron which would give about 2500 pounds on the arbitration bar. The tensile tests are from an iron which would run about 32,000 pounds on the arbitration bar. The transverse tests give some idea of the changes in the strength of the whole bar, while the tensile test measures the changes at the centers. As might be expected, the changes at the center are much more rapid than throughout the whole bar, and these changes, particularly those in the transverse test, seem less marked in case of the higher test iron.

Foundry Refinements Reduce Auto Costs

(*Concluded from Page* 179)

er lifts the mold from the machine with a traveling hoist and places it on a conveyor, where other helpers set the assembled cores and cope with the aid of jigs. It is claimed on good authority that where 15 years ago 1½ motor sets were produced for each molder employed, 24 sets now are produced.

Many changes have taken place in the melting operation. The air furnace and small cupola are not used extensively in foundries making automobile castings, large cupolas melting 20 tons or more hourly being used. Most of the metal melted in these cupolas is semisteel. This material is delivered and charged into the cupola by special machinery after being weighed carefully. The molten iron is carried from the cupola in large bull ladles and traveling cranes which carry it to the continuous conveyors where the molds are poured. The molds then are pushed down the conveyors, dumped and shaken out by special machines. The molding sand falls through the grating in the floor and is conveyed by a series of belts and elevators to the reclaiming station where it is riddled, tempered and delivered to the overhead storage bins at the molding floor.

While still red hot, the castings are loaded upon a motor truck and transported in lots of 30 or more to another conveyor where they are snagged and cleaned. In this department a gang of men work on the castings, each performing specified duties, such as removing the cores, fins and wires. The waste material drops through a grating onto an endless belt and is carried over a magnetic pulley which removes the wires and fins. The wires are reclaimed, the scrap is sent to the scrap department, the core sand is taken to the reclaiming station and later returned to the coreroom for use. The castings pass over more conveyors to grinders, air chippers and tumbling mills.

The entire melting operation is checked carefully, test bars of various descriptions being taken throughout the heat. Castings from various heats are broken daily to determine physical defects. The quality of semisteel has been improved greatly during the 20 year period through the development of various standards, testing machines, and microphotography. So much progress has been made that although the semisteel of today is much closer grained and stronger, having a tensile strength of 35,000 pounds or an increase of 10,000 pounds. It is machinable at a speed 50 per cent greater than that originally used.

Competition Is Strong

The Austrian aluminum industry reports that German competition is hurting its trade, not only in the domestic market, but also in the Austrian export markets, according to the United States department of commerce. German aluminum wares were said to have been offered at the cost of the metal. Swiss competition also has been felt.

Made Western Agents

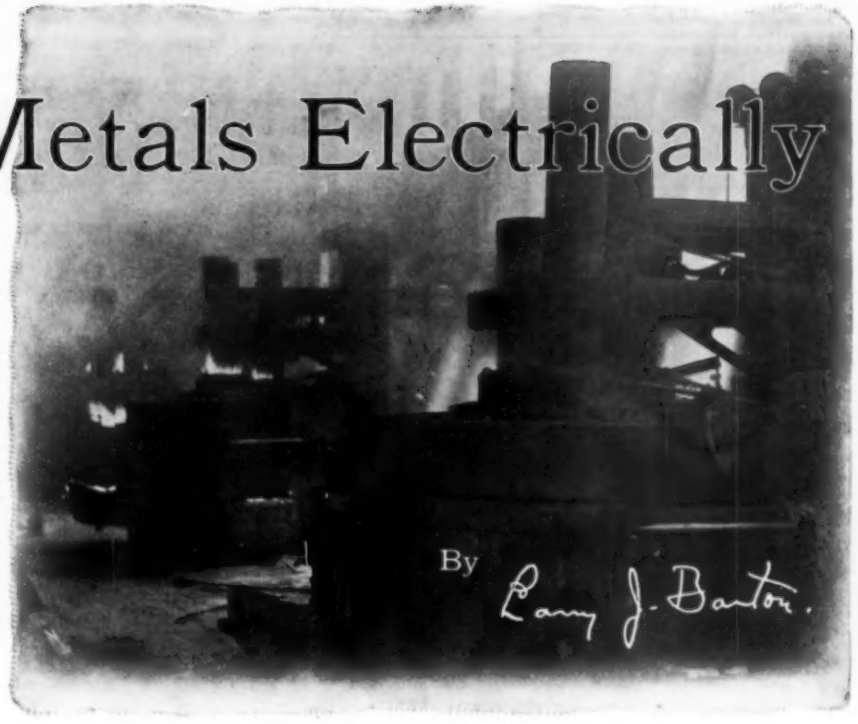
The Pacific Graphite Works, Oakland, Calif., has been appointed coast representative of the J. W. Paxson Co., Philadelphia, maker of foundry facings, supplies and machinery. A warehouse is being built to carry a stock of the new line of equipment.

Appointed Representative

C. R. Considine has been appointed representative in the Iowa and Minnesota territory for the Dings Magnetic Separator Co., Milwaukee, builder of magnets, magnetic pulleys and separators. Mr. Considine will have his headquarters at 1022 Langworthy street Dubuque, Iowa.

The George F. Crivel Co., 430 Ellicott square, Buffalo, N. Y., has been appointed representative for the J. W. Paxson Co., Philadelphia, in Buffalo and western New York, and will handle molding sands, supplies and equipment.

Refining Metals Electrically



Chapter V

Uses of Alloy Steels Increasing—Handling Nickel Steel

OF LATE years a considerable increase in the amounts of alloy castings made has been noted throughout the country. This has been caused, in part, by the gradual tightening of specifications, especially for castings used in the automotive industry. As it became more difficult for manufacturers to supply the demands of their customers from the ordinary grades of plain steel castings different alloys were developed. At first, results were not good, due to the lack of metallurgical knowledge in these lines. However, as time passed, more data were obtained through countless experiments, and the different steps in manufacture of alloy castings were so standardized that their commercial production became possible.

As soon as the worth of alloyed steel castings became apparent, considerable research was made to substitute these products for forgings. The results have been so satisfactory that each year shows a great advance in alloy castings use. Where a superior product with unusual qualities is desired, forgings often are of such a shape that the cost becomes excessive. Further, in many instances forging is impossible, due to the complicated design. In these cases alloy castings may be used to advantage.

That alloy castings of suitable strength have an important place in industry is proved. Some of their greatest advantages are as follows:

Castings of complicated shape can be made of equal strength, and at considerable less cost than forgings.

Castings can be used for purposes where a forging is unsuited.

With their greater physical strengths and ductility, alloy steel castings of a much lighter section can be used than forgings or some other classes of castings. This is extremely important in classes of work requiring a specified strength at a minimum weight, as for instance in automobiles, tractors, locomotives, and for reciprocating parts of machinery in general.

The same analysis of metal may be used for widely differing purposes, merely by changing the heat treatment. This is extremely important when the value of the casting as scrap is considered. For instance, the bucket pin of a dredge line—when made of manganese steel as formerly was the practice, the piece would wear enough on one side to cause it to be scrapped, the unmachineable properties of the steel causing the total value of the casting to be only that of scrap. On the other hand when a pin made of alloy steel becomes useless in the bucket line, it may be removed, annealed, and used for some other purpose. When it is considered that these dredgers are used many miles from a repair base these usuable steels are of the utmost importance for quick replacement when a breakdown occurs. Alloy steels may be used for keys, pins, washers, etc. Having a supply of old pins always on hand, the dredger foreman is never at a loss when an unforeseen accident occurs. He merely forges a pin to the size and shape desired, and then treats it either for greatest hardness or maximum toughness.

Castings can be made of any shape, and with any desired characteristic. They may be either glass hard, or exceedingly tough. Some classes of work can be made glass hard on the face, and tough on the back, as for instance in a crusher jaw.

Naturally, when the steel is made for such strenuous service it must be of the highest quality, and of absolute regularity, if the best results are to be obtained. This has resulted in the use of the basic furnace in the majority of cases, although there are some classes of alloy steels made extensively by the acid process. Whatever process is used, the furnace practice must be of the best from a metallurgical standpoint. Alloy steels require widely different furnace practice from that found standard for the plain carbon analyses.

Choosing Scrap

Some classes of alloy castings are worth, over 25 cents per pound, and a few dollars a ton difference in the scrap used is of slight consequence. Therefore, it is best to use a good grade of scrap metal for the raw charges. Scrap having a high percentage of loss during melting is not desirable, due to the percentage of oxide in relation to the area of the charge. Such classes of scrap as borings, turnings, light forge flashings, stampings, etc., fall under this classification. However, these classes of metal may be used if clean, being mixed with heavier scrap. Such classes of charging material as ingot butts, clean punchings, heavy boiler plate, low-phosphorus steel rail, old castings, etc., are excellent

Steel Alchemy

PHILOSOPHERS of old, charlatans in many cases, but in rare instances men who seriously were groping in the mists of ignorance for the light of scientific knowledge, sought the way to transmute base metals into gold. These men were called alchemists. From their experiments, from the blind blundering of undirected research came the science and the name of chemistry. When the addition of a few special alloys can impart desirable properties to steel castings and thus bring premium prices, the results may be compared to those sought by alchemists. In this chapter, Mr. Barton tells of the possibilities of special alloy steels. He introduces nickel steel and its methods of manufacture in the electric furnace. The next installment will give detailed furnace operation on nickel and chromium steel.

Table XXXXV

Analyses of Nickel Steel Slag

Heat	SiO_2	Fe	Al_2O_3	Mn	CaO	MgO	P	S	CaC_2
1	15.10	0.64	1.98	0.27	58.24	16.13	0.02	0.28	1.23
2	8.16	0.70	3.32	0.11	64.01	16.98	0.07	0.28	1.14
3	11.97	0.66	1.74	0.53	57.95	14.53	0.08	0.19	0.97
4	9.20	0.58	4.39	0.40	61.76	12.77	0.04	0.36	1.31
5	4.32	0.74	2.63	0.14	63.11	16.21	0.02	0.39	1.30
6	17.60	0.49	3.26	1.05	58.32	13.28	0.03	0.34	1.33

Corresponding Metal Analyses

Heat	C	Mn	Si	Ni	P	S
1	0.32	0.71	0.25	0.36	0.022	0.009
2	0.36	0.74	0.24	3.03	0.013	0.008
3	0.29	0.74	0.24	2.78	0.010	0.007
4	0.35	0.71	0.20	0.31	0.013	0.008
5	0.38	0.67	0.21	2.97	0.010	0.008
6	0.30	0.78	0.22	2.83	0.013	0.010

and usually may be had on the market at a few dollars per ton premium.

In certain instances a low phosphorus content is desired and to save long furnace manipulation it is often economical to melt down stock. Similarly, a supply of wash metal should be on hand for recarbonizing purposes, being far preferable to other materials, especially toward the end of a heat, when the opening of a door may be attended by adverse results, from the air being allowed to enter and fill the furnace.

Usually the great value of alloyed steel castings is found only in those castings which have been properly heat treated, such procedure bringing out to the highest degree the beneficial results of the alloy. Consequently, as all these steels are to have a finishing treatment more care must be exercised to prevent blowholes, and nonmetallic inclusions, as such faults manifest themselves in many disastrous ways, especially during the quenching operations.

Correct heat treatment requires regularity of chemical composition, making the services of a chemist an absolute necessity. As a well equipped laboratory usually is an important part of the modern steel foundry the requirement for a chemist is not out of the ordinary.

Making Nickel Steel

OF THE different alloys being used for alloying with iron for commercial castings, nickel ranks among the most important. Nickel confers on the steel certain properties, among the most important being a higher elastic limit and tensile strength without decrease in ductility. It alloys in all proportions with iron, this combination occurring at rather high temperatures, between 1500 and 1600 degrees Cent. Nickel tends to check segregation, probably by its ability to raise the melting point of the steels constituents to the point where solidification becomes more uniform than on plain carbon steels. Nickel steels, especially those of the higher percentages are subject to blowholes and the greatest care must be used to eliminate them before pouring as such defects are difficult to weld properly. It is most difficult, if not impossible, to weld nickel steel containing over 4 per cent nickel. Due to its quick setting characteristics, this class of metal is likely to contain laps and seams, requiring considerable attention to pouring temperatures, and speed of flow into the mold.

Nickel steel castings are rugged, standing an abnormal amount of abuse before failure. Consequently, they find extremely wide use in classes of work

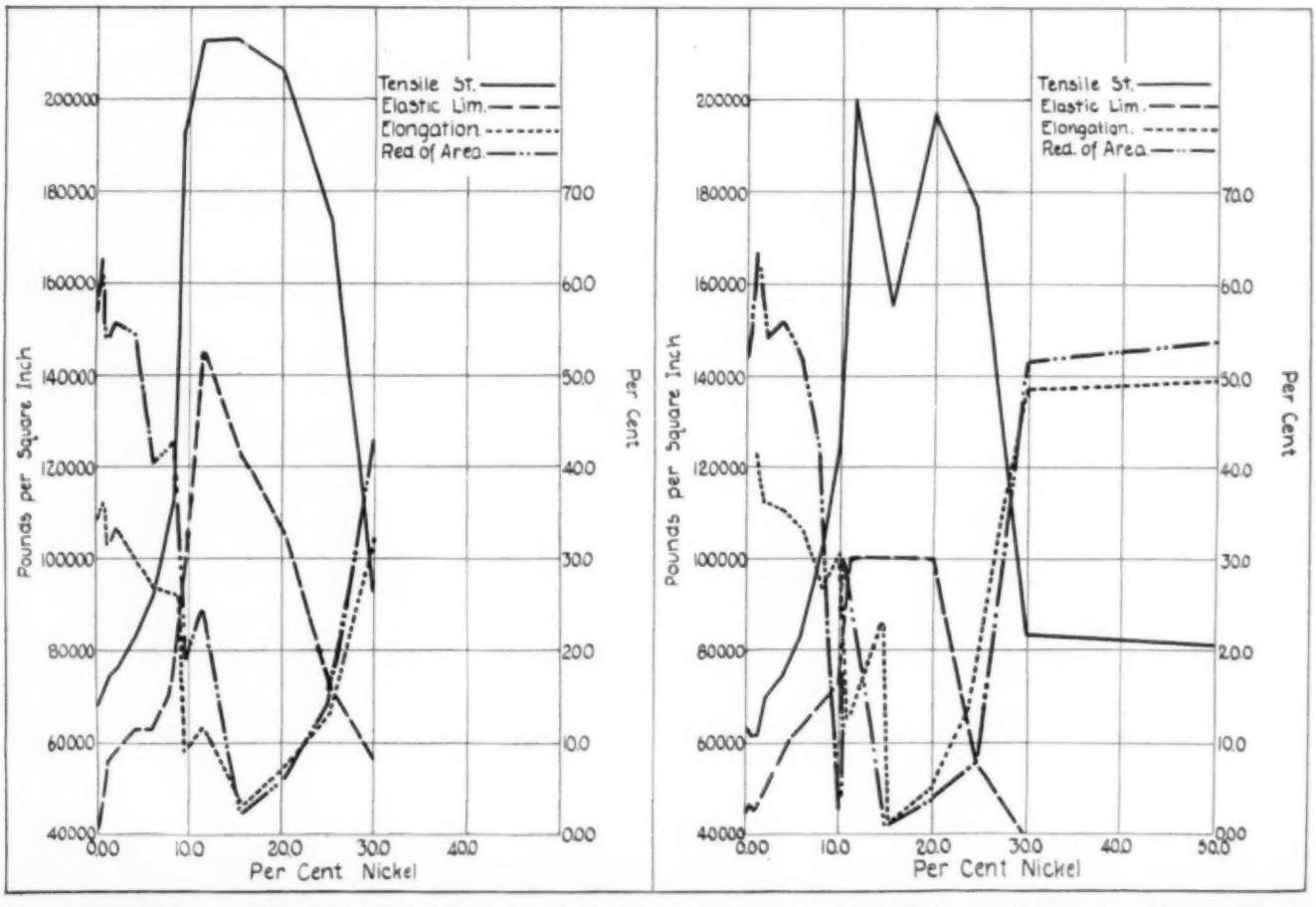


FIG. 42—CHANGES IN PROPERTIES DUE TO THE ADDITION OF NICKEL. THE CARBON AVERAGES 0.17 PER CENT AND THE MANGANESE, 0.82 PER CENT AND THE SPECIMENS WERE UNANNEALED. FIG. 43—ANNEALED SPECIMENS OF NICKEL STEELS, AVERAGING THE SAME IN CARBON AND MANGANESE

where a high elastic limit is desired, or where a metal with high resistance to shock is required. In many instances nickel steels are used where a certain specified strength is desired with a minimum of weight, their high tensile qualities enabling nickel steel to fill the specification with a casting of lighter section than otherwise would be required.

Three classes are widely specified for the ordinary commercial grades of nickel steel castings. The classes are divided into those containing from 1 to 1.5 per cent nickel; those from 2 to 2.5 per cent; and those from 3.25 to 3.50 per cent. Each class is made with carbon to suit, generally ranging from 0.15 to 0.45 per cent. While other percentages of nickel are in use, such as the 4 and 5 per cent grades, they are in the minority. For special purposes, nickel steel mixtures containing up to 36 per cent nickel are used, but these are specialties made only in shops primarily intended for their manufacture, similarly to manganese steel.

Nickel is difficult to oxidize from steel, making its melting simple. Either the acid or the basic process can be used to advantage, both on remelting nickel steel scrap and in the manufacture from carbon steel scrap. Comparative advantages of the two processes will be the same as those outlined for melting carbon steel.

Acid Furnace Practice

The best method of adding the nickel is to mix it in with the charge, either in the form of nickel pig, or shot. As soon as the heat has melted, it is checked for carbon by the chemist. Little information can be obtained from the appearance of a fracture on nickel steels, and this judging of the carbon by this method is so uncertain that its use should not be allowed.

Nickel may be added quantitatively as there will be practically no loss entailed during melting. The heat can be regulated for carbon and manganese according to the chemists analysis, the best method of adding the carbon being in the form of wash metal, enough nickel being added to compensate for this addition in weight.

The slag should be manipulated exactly as if a heat of carbon steel was being made, and when the familiar yellowish-green color, with proper viscosity is obtained, the metal is ready to pour, providing the temperature is sufficiently high.

Alloys such as manganese and silicon may be added in various ways, but the best results are obtained by finishing all the alloy steel in the furnace. As soon as the metal becomes rather hot, the slag is thickened by the addition of sand, and the metal held until sufficient silicon has been reduced to furnish adequate solidity in the mold. This is a matter of experience and should not be attempted by an inexperienced melter. He should add his manganese to the furnace and the silicon to the ladle in fine pieces until he is sure that he can judge the silicon properly in a reduced test. This period of reduction generally will take from 10 to 12 minutes, depending upon the temperature of the metal, the character of the slag, the size of furnace and the power input. Usually it is different for each installation.

Heat Metal High

If any alloys are added to the ladle, the metal should be heated higher than is ordinarily practiced that thorough assimilation may be assured. The metal should always be held in the ladle for at least five minutes, and ten if possible, to avoid any possible chance of slag remaining in the steel. If the heat is poured under a thick, viscous slag, the chance of an inclusion is small, any small amount which is trapped during pouring rising to the surface when the steel is held in the ladle.

Best results are to be obtained by the use of a bottom pour ladle, and the metal should be *hot poured*. A regular stream must flow into the mold, and the metal should be sufficiently hot to run without any lagging, or laps and seams will result.

Remelting nickel steel scrap offers no particular difficulty aside from the general considerations governing the manufacture of any high grade metal. Nickel will not oxidize out of the scrap, so there need be no worry about analysis if proper calculations are made at the start of the heat. Should the carbon come down high it may be lowered by boiling with oxide, ore being preferable to scale for such purpose, and the heat finished in the ordinary manner.

Occasionally, a heat of nickel steel will go wild in the furnace, and if it contains a high percentage of nickel it will be extremely difficult to deoxidize. The ordinary classes of deoxidizer such as manganese, silicon, titanium, vanadium, etc., will have no effect, even though added in considerable excess. However, two metals will quickly degasify nickel steels. These are aluminum and magnesium. Aluminum if added in excess, has the undesirable property of making the steel much harder than usual and if used, great care must be exercised. On the other hand, magnesium will give the desired results with a smaller amount used. A supply of this metal should be on hand in shops making nickel steels.

In a wild heat, the metal should be brought up to its proper composition in carbon, manganese, and silicon, these elements being slightly higher than desired.

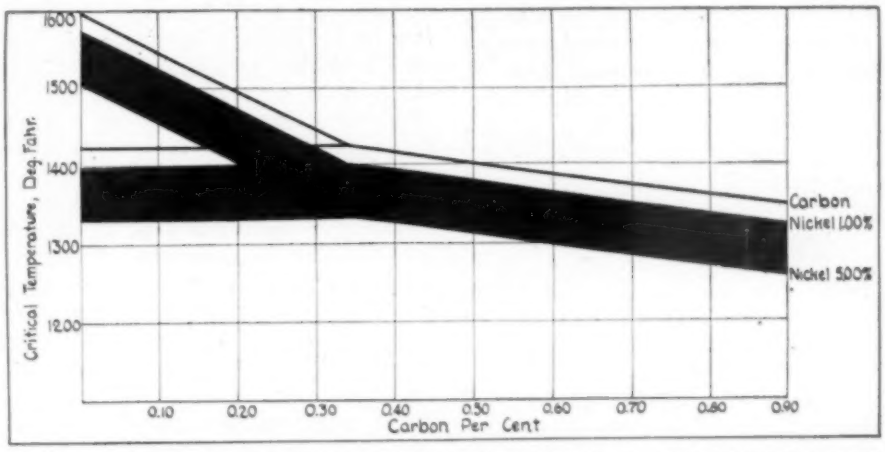


FIG. 44—EFFECT OF VARYING AMOUNTS OF NICKEL ON THE CRITICAL TEMPERATURE OF STEELS WITH VARYING CARBON CONTENTS

As the heat pours from the furnace small pieces of stick magnesium should be added to the stream flowing over the furnace spout. The ladle should be held until foaming of the slag or gassing ceases, when the metal may be poured. No figures as to the quantity of magnesium required may be given, as this depends strictly upon the degree of wildness, the amount required ranging from an ounce to a pound, per ton of steel. Heats killed in such manner never should be used for castings requiring extreme quality.

Melting Basic Steel

Basic furnace practice on nickel steel follows closely the practice outlined previously. The nickel may be added either with the charge, or after the heat has melted. The bath and slag should be brought to the proper conditions of temperature and carbide state, the manganese and silicon added and the heat poured.

In the basic steel about two pounds of pulverized fluorspar per ton of metal should be added to the bottom of the ladle before pouring. Fluorspar has the ability to combine rapidly with any slag

in the metal, lowering its melting point so that it makes its way quickly to the surface. A few shovels of burned lime always should be thrown on the top of the ladle to thicken this slag. This should be covered with a little coke to make it retain its reducing character during the period of pouring.

The amount of slag to use in basic operation will be determined by the percentage of sulphur which it is desired to eliminate. Priestley, in *Blast Furnace and Steel Plant,* Jan. 1922 gives some interesting analyses covering electric furnace slags from nickel steel heats, together with the corresponding analysis of metal.

The quantity of slag used was approximately 3 per cent of the weight of the metal, the bath being held under this carbide condition from 3 to 5 hours. The product was used in making armor steel. The preliminary percentages of sulphur contained in the metal averaged 0.02 per cent. The analyses given by Priestley are shown in Table XXXXV.

From these figures it may be seen that the slags are in no particular different from those found on carbon steel operations.

Finishing Heats

In a shop specializing in the manufacture of alloy steel castings, the practice of deoxidizing under air tight conditions should be adopted, not only on nickel steels, but on all of the alloyed heats. At first, it will require considerable experimenting to determine accurately the carbon pick up from a certain amount of carbide slag held a specified time in the furnace. However, this is determined easily and results made under similar conditions will average close. From the heat records, the weight of slag required to eliminate a specified amount of sulphur, and to thoroughly deoxidize the metal may be determined. From checking the carbons closely by taking tests every few minutes, the average pick up of this element over the finishing period can be obtained.

The next step is to finish the carbon adjustment to the point where the contained analysis, plus this average pick up, will give an analysis of the desired figure. Then the final slag is added, a good dusting of coke added, and the doors closed and all openings tightly sealed with a luting of mud or clay. Soon the furnace will begin to *snow* slightly, and the openings around the electrodes gradually will build up with the soot to the point where the furnace is absolutely air tight. Then the heat is held for the determined time, when the final test can be taken and the metal tapped. Steel of unusual quality is made by this method, and is regular in its chemical composition. There is no question but that this absolute elimination of oxygen from any entering air results in metal of superior quality. Eliminating nitrogen from the furnace also may be one of the reasons for this improvement as in the presence of such an intense arc the fixation of nitrogen, and its attendant absorption in the steel, is a point which is slightly probable. It is well known that this gas in steel has as much influence, if not more, than oxygen in lowering the quality of the metal. This point is well illustrated by the superior results from steel in which part has been treated with titanium, vanadium, or uranium, their greatest value lying in the fact that they may have the power of removing this nitrogen.

It will be necessary to determine this carbon pickup for several weights of slag, as the volume of slag used will change, depending upon the amount of oxidation the metal has experienced before its finishing. A heat made of clean steel will become perfectly sound in about an hour under a 3 per cent lime slag, heavy in carbide, while one of rather dirty scrap may require two hours under a 5 or 6 per cent slag. However, these points will take care of themselves in any well supervised shop. They are mentioned merely as a point of interest.

While 1 per cent of nickel will raise the tensile strength and elongation about 4000 to 6000 pounds per square inch over a plain steel of corresponding carbon content, with no lowering of the elongation, bend, or reduction of area, this ratio holds only up to about 5 per cent nickel, where the increase would amount to only a maximum of 30,600 pounds per square inch. When it is considered that a simple treatment will give the same result on a 2 per cent nickel steel, as on a natural 5 per cent alloy, it is readily seen why all such castings are heat treated. If there was no increase in physical qualities, the question of cost would determine this point, but the vast differences between raw and treated castings is an item far superior to that of the added cost of a few per cent of nickel.

Nickel has the same effect upon steel as carbon, although to a greater degree. It lowers the transformation points. For the ordinary grades of nickel steel used in casting work, from 1 per cent nickel up to 4 per cent, 0.50 per cent nickel will lower the Ac_1 range about 10 degrees Fahr. and the Ar_1 range on cooling about 20 degrees Fahr., from those of similar contents in plain steels. The approximate critical temperatures of these steels run from about 1325 to 1310 degrees Fahr. (Ac_1), 1250 to 1230 degrees Fahr. (Ar_1) for the 1.00 per cent nickel to about 1250 to 1270 degrees Fahr. (Ac_1), 1100 to 1120 degrees Fahr. (Ar_1) for the 4.00 per cent nickel, depending upon the differences is miscellaneous composition, carbon, manganese, etc.

Nickel steels offer a distinct difference from plain carbon steels when heated above the critical points for any length of time, carbon steel tending to grow in grain size while nickel steels tend to become finer and closer in grain. Of course, this statement does not mean that such superheating is desirable as heating for continued periods at such temperatures naturally will weaken the metal. Such a characteristic is a greater advantage in handling work of large size, or heavy section, as the time of soaking may be prolonged, during which period the grain is being refined to a marked degree, a point directly the opposite of the plain carbon steels. While this added heating tends slightly to raise the cost of treating, this would be a secondary consideration when dealing with products of the highest quality. Fig. 42 and 43 show the changes in a steel due to increasing its content of nickel.

Fig. 44 shows the manner in which certain percentages of nickel affect the critical temperatures of steels of varying carbon contents.

On small size castings, the general practice is to heat slightly above the upper critical range, allow them to soak until the heat is diffused thoroughly throughout the piece or pieces being treated, withdraw from the furnace, and quench in either air, oil or water, depending upon the shape of the piece, and the desired specifications. These pieces are then drawn back to the temperature necessary to give the desired toughness. On larger sized castings, it often is necessary, and usually desirable, to give a double quench that the transformation may be complete, nickel having a tendency to retard this action. Brinell hardness numbers will range from about 175 on the annealed specimens of medium steels, to 400 on some of the harsher quenches.

Foundry Is Taken Over

The Davis Pipe & Fittings Co., 830 North Forty-sixth street Birmingham Ala. has acquired the plant of the Iron City Pipe & Foundry Co., at 4000 North Thirty-fourth street according to Ben Davis, president of the former company. Following improvements and additions the Davis company will continue operation of the latter business.

The Ann Arbor Aluminum Foundry Co., Ann Arbor, Mich., recently organized, has begun manufacturing brass and aluminum castings. The foundry will be operated as a general jobbing plant. C. W. Delaney, J. P. Riley and M. J. Kelly are in charge of the plant.

INSTALLATION AND CARE OF AIR COMPRESSORS

(*Continued from Data Sheet No.* 562)

Another form of air cleaner which can easily be made at any plant is shown in Fig. 2 and consists of a metal tank in which several layers of washed cobble stones are set, these stones being laid on heavy wire mesh partition

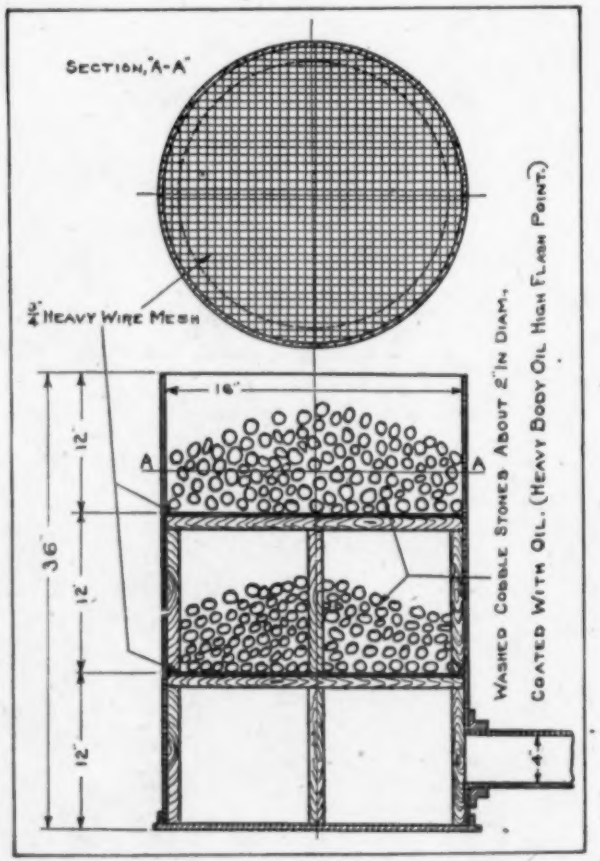


FIG. 2—A METAL TANK FILLED WITH STONES COATED WITH A HEAVY OIL MAY BE USED TO FREE INTAKE AIR FROM DIRT

(*Continued on Data Sheet No.* 564)

INSTALLATION AND CARE OF AIR COMPRESSORS

(*Continued from Data Sheet No.* 563)

plates. The stones are coated with a heavy high flash point oil. The dust in the air passing through the mesh partition plates adheres to the oil. Such a cleaner can have the stones removed periodically and cleaned.

There are different forms of filters which can be purchased as manufactured articles which are made to attach to the intake pipes of compressors. One which has had considerable use consists of a box with a filter shell containing short brass tubes covered with *Viscosine*. This filter gives good results with a negligible pressure drop, and only requires cleaning once every six to ten weeks, depending on the service to which it is put. Other forms of filters on the market are those which consist of a large surface of special felt, through which the air must pass, and others which have a fan operated by the rush of air through the intake pipe which operates a centrifugal device and is supposed to whirl the dirt out of the air. Any filter which will actually clean the air may be used.

B The air discharge pipe should be full size of discharge opening on the air cylinder. This pipe should drain to the air receiver and should be allowed to form no pockets. The distance between compressor and air receiver must be as short as possible, with the reduction to a minimum degree of sharp bends and fittings, thus increasing the efficiency by reducing the friction. A globe or gate valve should not be placed in the discharge line between the compressor and air receiver unless a pop safety valve of sufficient area is installed in the discharge line on the compressor side.

AFTERCOOLERS

C Moisture in air always is a source of trouble where the air is to be used in reciprocating mechanism. Moisture carried into the machines with the air tends to wash away the lubricant and to increase the wear by leaving bare surfaces in moving contact. This is true particularly in high speed machines such as pneumatic hammers and drills, air motor hoists and sand rammers. Where the wearing surfaces necessarily are limited in size and wear, the moist air may be the cause of increasing air leakage.

(*Continued on Data Sheet No.* 565)

THE FOUNDRY DATA SHEET, MARCH 1, 1925
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Around the World with The Foundry

Little Journeys to the homes of our readers

Belgium!

PROBABLY more history has been made and more human lives destroyed in what once was known as "The Cock pit of Europe" than in any territory of equal area in the world. Napoleon's meteoric career was checked at Waterloo and within the last few years the warring nations of Europe once more have drenched her soil with blood.

When Col. McRae wrote: "In Flanders fields the poppies grow, between the crosses, row on row", he might have added that every poppy in Flanders fields is rooted deep in a buried soldier's heart.

Notwithstanding the manner in which she has been ravished and raided, torn apart and reassembled to suit the whim and convenience of her powerful and sometime mercenary neighbors, the country has grown and prospered and enjoyed the distinction for years of being the garden spot and most densely populated country in Europe.

Castings are made in 314 foundries and out of that number 37, including Fonderies Medhaniques d'Anvers, Antwerp, and Fonderie et Trefilerie de Bronze Phosphoreux, Anderlecht, Brussels, are subscribers to The Foundry.

"Wherever metals are cast you'll find THE FOUNDRY"

Farms Depend on Castings Shop

By Pat Dwyer

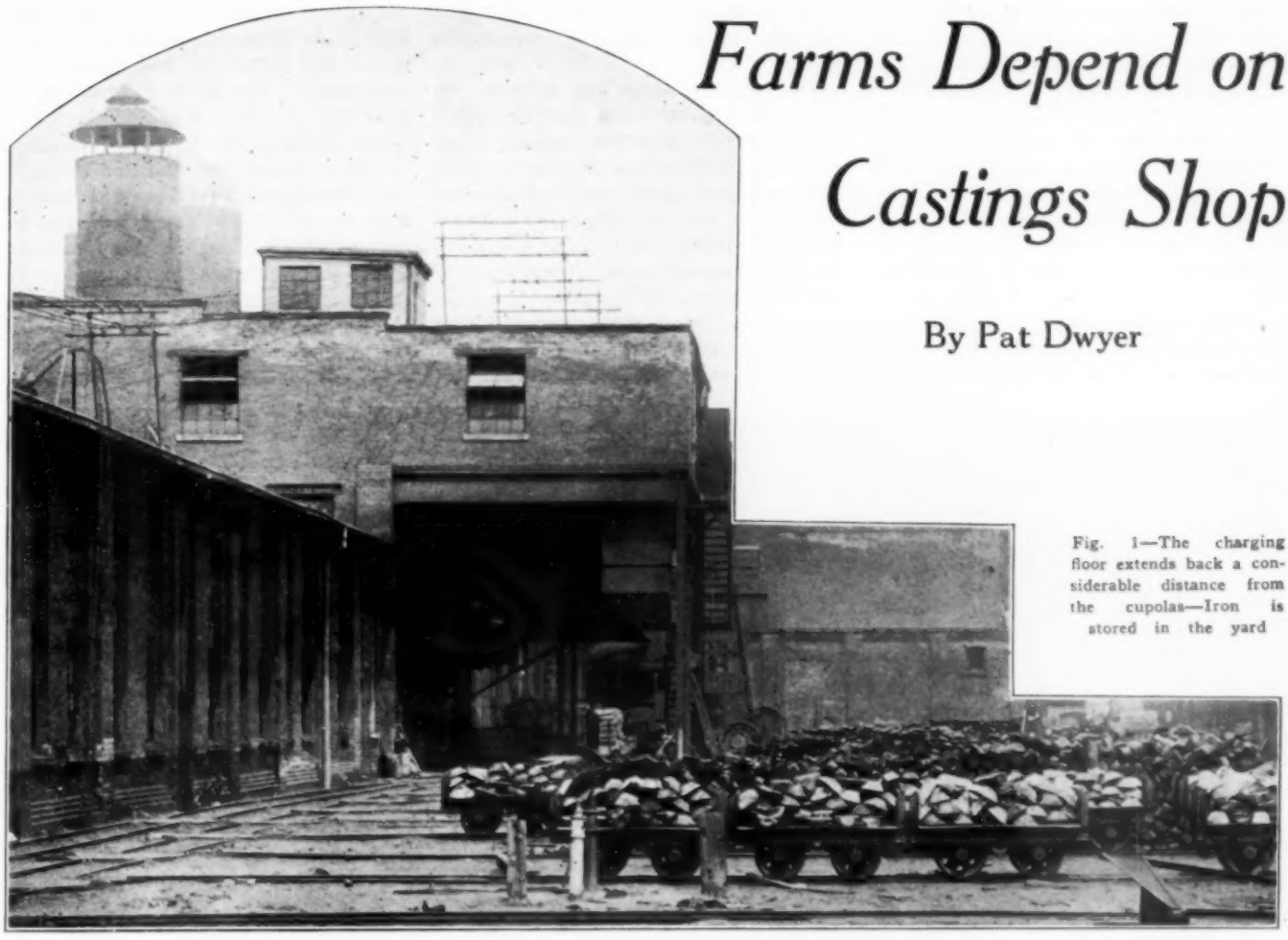


Fig. 1—The charging floor extends back a considerable distance from the cupolas—Iron is stored in the yard

AGRICULTURE is as old as the history of the human race for the simple reason that whatever man has done or has not done he has had to eat and his food has been a product of the earth either directly in the form of plants or indirectly in the form of animals that have lived on plants. Records dating back to the time when Abel was a keeper of sheep and Cain attended to the harvests of the field indicate that always a distinction has been observed between these two main branches of the agricultural industry. In recent years the tendency has been to bring them together at least to the extent that where they are practiced they come under the supervision of one person, but in many instances even to the present the division still is observed. Truck gardens in the east, wheat and corn fields in the middle west and ranches in the far west illustrate these phases in a striking manner even here on the North American continent, which is only one of the six great divisions of the earth.

So many factors are responsible for the changed conditions represented by the difference between the power driven gang plow and the pointed stick, at one time employed in grubbing the earth for corn that it would be idle to speculate on which has been the most important. A natural evolution that accompanied the march of civilization did a great deal to improve agricultural conditions and facilitate feeding a constantly increasing population. Evolution was comparatively slow until after the middle of the twentieth century when the extensive application of steam power to transportation not only brought the cities and agricultural districts of individual countries within hail of each other, but made possible the exchange of perishable commodities between continents separated from each other by half the earth's circumference.

Sheep born and raised in Australia end their career in London. Miles of undulating grain turned to shining waves of gold under the amorous influence of the summer sun on the plains of Argentina ultimately are delivered in Barcelona or Constantinople. Cattle in England are fattened on cake made from cotton seed that may have grown in Louisiana, in Egypt or in India. Bully beef that played no inconsiderable part in winning the late war, if its value is to be gaged by the number of times it was referred to in the news items that appeared during that period, had its origin on the western plains of North America or on the pampas that are watered by the Amazon and its thousands of important tributaries.

Facilities provided by improved methods of transportation created immense markets that stimulated agricultural production. Necessity of meeting increased production schedules resulted in the invention and application of mechanical devices that to a great extent have displaced the old laborious hand methods of a former generation.

During a recent period of 66 years, it is claimed that human labor involved in the production of a bushel of wheat has been reduced from 3 hours, 3 minutes to 10 minutes and the cost over the same period has been reduced from 17⅜ cents to 3½ cents. Another statement freely circulated several years ago in any discussion touching the raising or marketing of wheat was that the reaper, invented and developed at a time when harvesting on the wheat belt was hampered through scarcity of men following the close of the Civil war, resulted not only in taking care of current requirements but was responsible for pushing back the American western frontier at the rate of 50 miles a year.

The lead taken by American manufacturers of agricultural machinery always has been maintained. In addition to supplying machinery on their own continent they supply the greater part of the machinery employed in every country in the world where edible grain is culti-

vated either for home use or for export. Implements of many kinds represent the combined and crystallized ideas of many men working over a long period of nearly 100 years. The same forces that nationalized and in many instances internationalized business also centralized the manufacturing activities of those engaged in the exploitation of agricultural implements until today they are represented by two powerful corporations, one in the United States and the second in Canada. The latter is the Massey-Harris Co., which maintains a head office and immense manufacturing plant in Toronto and other subsidiary plants and warehouses in several Canadian cities.

The gray iron foundry 120 x 900 feet is divided longitudinally into three main bays with the exception of the cleaning room which occupies a space the full width of the three bays at one end of the building and a four-story coreroom which occupies a similar space at the other end. A concrete-lined basement extends practically under the entire foundry and serves at one end for a storage for coke and sand and at the other end as a storage and shipping room for the cleaned castings. An immense stock of castings is maintained as a balance wheel against seasonal requirements. It also is an important factor in the perpetual inventory system in force in the plant. Castings are stored in bins marked in a suitable manner. The number taken out and the number replaced are checked each day and in that manner the number of pieces on hand at any time is on record and may be ascertained at a moment's notice.

Brick walls in which long windows are spaced at distances of a few feet apart enclose the building on the ends and sides and serve as an important factor in maintaining a desirable temperature in the building both in winter and summer. The roof of the building supported on wood columns and beams is comparatively low since all the castings are light and no heavy traveling crane is required to handle the loads. The part of the roof above the center bay is higher than that over the adjoining side bays and is provided with a double row of windows along the monitor projection in the center which extends from one end of the building to the other. The building faces directly on the street along one side. The other side forms one boundary of a stockyard where the pig iron and scrap for the cupola charges are piled in neat and orderly formation.

Sand Stored in Basement

A spur track from the main line of the Canadian National railroad enters the property at one end. It is connected with many branches within the boundaries of the plant and facilitates the reception of raw material and the first step in the outward journey of the finished product. One branch extends through the foundry yard close to one side of the building so that sand and coke may be unloaded directly into chutes leading to the various bins in the basement. Core sand is stored in the basement at a point in the vicinity of the core room. Molding sand is stored at a more central point.

The majority of the castings made in this foundry are light and thin in section and therefore do not burn the sand to any extent. This factor reduces the amount of new sand required from day to day to approximately the amount required to replace the sand that adheres to the castings. New sand is loaded into trucks in the basement and taken up to the molding floor level on elevators situated at convenient points. Gangways covered with iron plates extend through the various bays and greatly facilitate the transfer of materials. Flasks, sand, patterns, cores and molding machines are trucked from point to point. Molten iron is conveyed in round bottom, cast-iron ladles suspended from a monorail that extends to all points in the building where molds are made. That part of the line in front of the cupolas is shown in Fig. 2. The ladles form an interesting connecting link between the past and the present and are practically the only equipment that has not changed in conformity with the many changes involved in converting this from a hand operated to a mechanically operated foundry. In justification of the continued use of these ladles, it is claimed that they furnish perfectly satisfactory service, barring unforseen accident they last indefinitely, and with a

Fig. 2—Old fashioned cast iron ladles constitute an interesting connecting link between ancient and modern practice. This was one of the first foundries to introduce mechanical conveying equipment

pattern in the shop they easily may be replaced at practically no cost. Another reason and one that perhaps will appeal more to those interested in personnel relations is that the men who are delegated to convey the iron from point to point are accustomed to these ladles.

Minimum weight combined with requisite strength to withstand any strain to which it may be subjected are the two outstanding features in the mind of the men who design agricultural machinery. The light, graceful and thoroughly efficient pieces of mechanical equipment employed on the farms today bear little resemblance, except in the basic principles, to the machines used by the pioneers in the transformation of the prairie lands of the west. As a result of this refinement in construction, nearly all the castings are of a size that may be poured with a hand ladle. A few castings, too heavy to be poured from one ladle, are poured from two and sometimes three hand ladles. In the latter case, multiple pouring has an advantage in that hot iron is distributed simultaneously to all parts of the mold.

Iron is melted in three, 72-inch inside diameter cupolas, two of them located about 300 feet from one end of the building and the other about 300 feet from the other end. Each unit of the pair of cupolas served from a common charging floor is used on alternate days. The entire melting installation including tracks, turntables, transfer car, charging cars and cupolas was supplied by the Whiting Corp., Harvey, Ill.

Coke is delivered on the charging platform by a long belt conveyor that serves all three cupolas. A vertical bucket elevator lifts the coke from the storage pile in the basement of the building and discharges it upon a moving horizontal belt. Stops or plows are provided at suitable points above the belt to divert the coke from one charging platform to the other as required. A gong signaling device operated from either platform notifies the attendant at the coke elevator when to start and stop the supply of coke. One advantage claimed for this method of conveying the coke to the charging platform is that it prevents delay and congestion on the main elevators which are used exclusively in raising the iron charges from the yard to the charging floor.

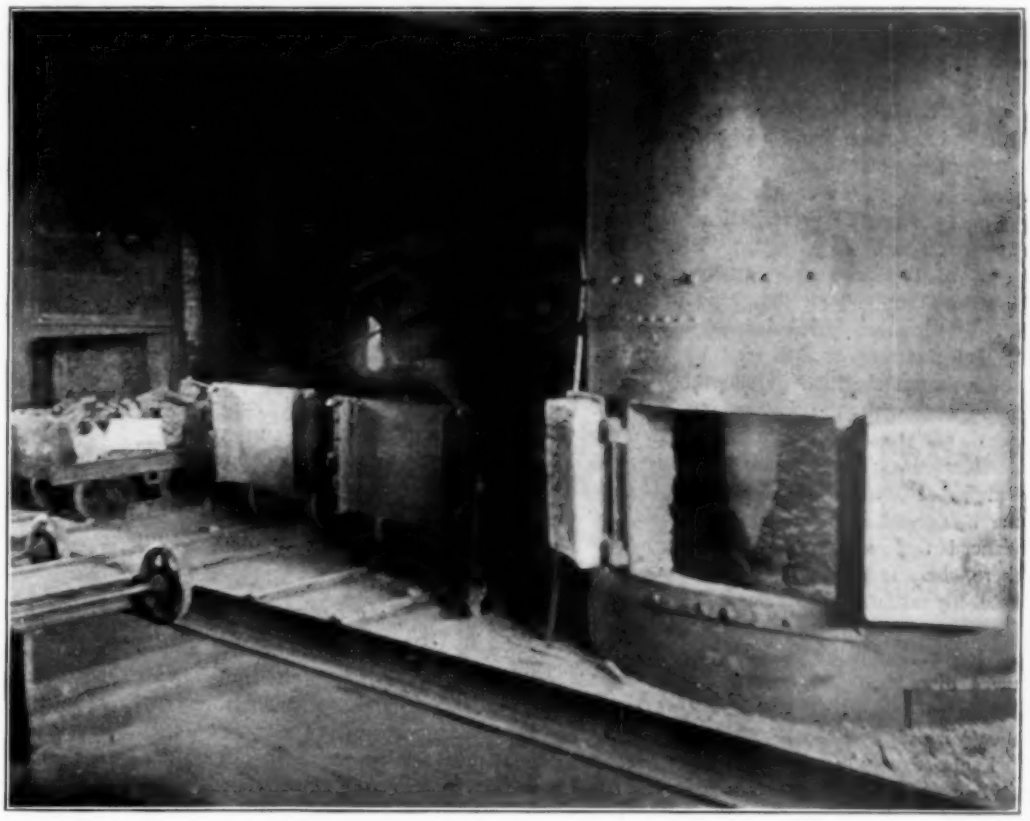


Fig. 3—Cupolas originally designed to be charged by hand through a single door in front, now are charged mechanically through doors on both sides. Cars carry the iron

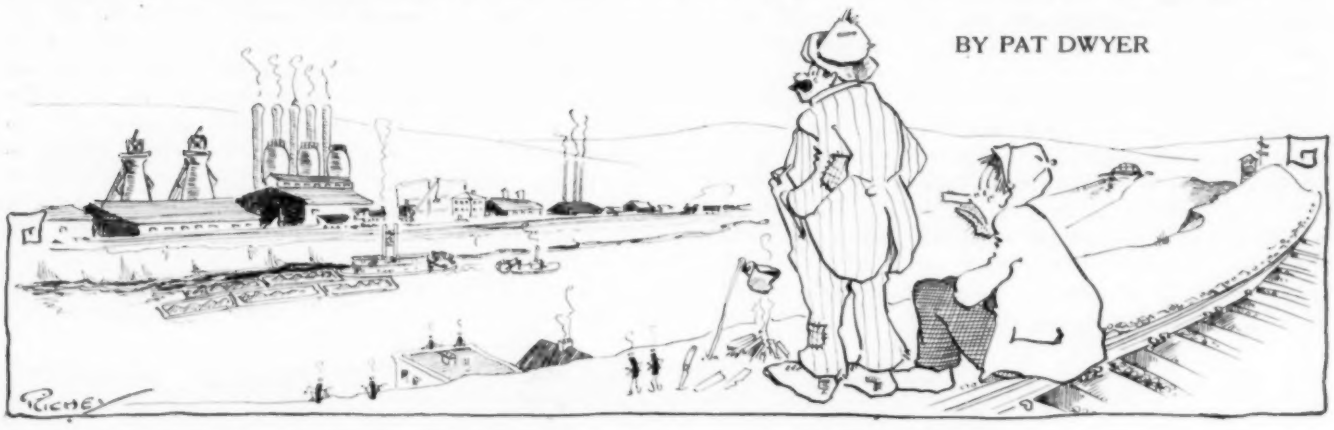
Make Up Iron Charges

From a glance at that part of the stockyard shown in Fig. 1 it may be noted that a number of short tracks are laid from the various stock piles to the main line extending at right angles, and lying close to the wall of the building. Charging cars are pushed by hand on these short tracks and loaded with iron from specified piles. They are pushed back to the point where the short track joins the main line and are shifted on a turntable from one track to the other. The material is weighed in the vicinity of the elevator, before it is lifted to the charging cupola floor. The charging floor partly, shown in Fig. 3, is provided with a number of tracks laid on the floor and pointing toward the cupolas. A transfer car operates on a depressed track laid at right angles to the other tracks and serves to shift the loaded cars from any one of the storage tracks to a point on either side of the cupola where the charge may be dumped in through the doorway. The empty cars are returned by the same route and are placed on a track that leads to the elevator which returns them once more to the stockyard.

Canadian, Scotch and American pig iron are melted at different times depending usually on the state of the market and the facilities for delivery at the time the contracts are placed for supplies. Satisfactory results are secured from the use of any of the three varieties. Minor modifications are made from time to time, but the usual mixture is made from up from half pig iron and half scrap to meet the following approximate analysis: Silicon, 2.50 per cent; sulphur, 0.08 per cent; manganese, 0.60 per cent; phosphorus, 0.75 per cent; total carbon, 3.75 per cent. The cupolas are supplied with air by a positive pressure blower made by Waite Bros., Bradford, England. It is located on a mezzanine floor and connected to two cupolas through a suitable pipe arrangement. A description of the core room, cleaning room and interesting details of molding practice will be presented in an early issue.

Bill Discusses Bricks, Old and New

BY PAT DWYER



ONE night recently I pried a young hero loose from his book and sent him off to bed. The book, I need hardly say was not one of those he uses in school, prescribed by an omnipotent board of education, designed to bend the twig and show the young idea how to shoot and all that kind of thing. Interest in this particular book centers around shooting of one kind or another, but it is not the kind of shooting usually associated with the young idea in the mind of the board of education.

After the young scholar had retired and peace once more had settled over the household, I picked up the book and glanced through a few pages here and there, but found nothing to attract or hold my attention or interest. The preface announced that this was one of a series dealing with the life and adventures of a trio of young backwoodsmen in the early days of Kentucky, Ohio and the Virginias.

I closed the book with the regretful feeling that probably advancing age has changed my viewpoint and dulled the finer perceptions that at one time caused delightful thrills during the perusal of similar stories in a now extinct paper covered periodical published weekly and rejoicing under the title *Beadle's Dime Library*. I devoured those stories at night, before school, after school and —when I had a chance—during school hours. Occasionally in later years I have read biographies of famous citizens and noted that without exception these lads have paid tribute to their teachers. A few openly and brazenly stated that they loved them. Others, either through a natural regard for the truth or because mature experience has rendered them cautious and therefore adept at sidestepping, refer to their school days in a more guarded manner, but in the main even these lads allow the reader to draw the same inference.

I have no intention of writing an autobiography and it is extremely improbable that any other person ever will see the necessity of attempting such a task, but if I do, or if one of them does, the future reader will find no bouquets presented to my teachers.

Every one of them was an adept with the strap or the cane. A few wielded both with equal facility and used them on little or no provocation. Turning one cheek or one hand after the other has been blistered may appeal to some people, but when the official roll is called you may count me out.

Did He Escape?

Time is a wonderful healer, and I long ago have forgotten the blisters on my hands and forgiven the cruel old tyrants who under cover of their official position gave their angry passions free rein and put them there. Perhaps in some instances the punishment was deserved and—as we frequently were reminded—may have been a factor in later years in keeping me out of the penitentiary. I have an opinion of my own on that point, but I am not going to argue over it now. I hate arguments. Usually the other fellow is too stubborn to be convinced. You probably have noticed that.

One little bewhiskered crab I never have forgiven. He came sneaking up on tip-toe behind my desk one day while I was following breathlessly the adventures of Gordon Lilly the Boy Chief of the Pawnees. Just as the hero felt the hot, fetid breath of the huge grizzly bear on his face and realized that in another instant he would be clasped in a fatal embrace, I got a lick of a strap across the shoulders and saw my beloved book snatched from inside the charitable covers of the geography.

The old lad read the assembled class a fiery lecture on the perversity of modern youth and the probably immediate and ultimate fate of those who indulged in such a pernicious form of literature. He did not call it literature. I am afraid he showed such shocking taste as to refer to it as trash. He touched me up artistically with the strap before the class, kept me in after school and—crowning misfortune of all—he threw the book in the stove.

Ultimately, I recovered from the effects of the strap and the detention. The memory was blotted out by subsequent repetition, but I never have recovered from the fatal gap left in my mind regarding the fate of young Mr. Lilly. Was he crushed to a pulp and then tossed aside like an old chew of tobacco? I hope not, but you never can tell. Experience should have taught me that invariably the hero was rescued at the last 0.003 part of a moment, but that fractional part of a moment usually was the most intense in the book and I wanted to live through it. I wanted to stand at some convenient point on the side lines and watch while an unseen hand whanged a long feathered arrow through the monster's

NO MY DEAR THIS IS NOT MOSES IN THE BULLRUSHES

vitals and caused him reluctantly to release his vise-like grip on the hero. Alas! I never found out definitely. Since the addition of the sterling romance long since has been out of print, it is extremely improbable that my curiosity ever shall be satisfied.

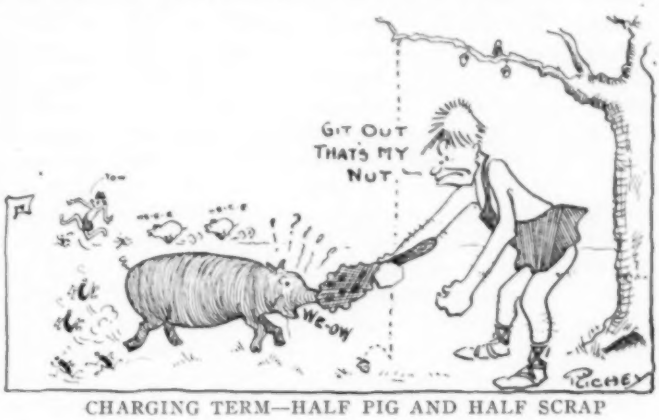
At the time I was engaged in reading these masterpieces and for many years afterward, I lived in a little town 2000 miles away from the scene where most of the exploits were laid in the historic territory adjacent to the Ohio river. In those far away days I had no expectation of seeing this favored land, and although I knew in a general way that conditions had changed, still I preferred to retain my first impressions. Instead of a great state thickly studded with towns and cities and vast manufacturing enterprises, a state in which a population of six million people enjoy all the comforts, conveniences and luxury of modern civilization; the name Ohio always conjured a vision in my mind of a broad and noble river on which a small band of pioneers floated in a flat boat.

I was somewhat hazy about where the boat came from or where it was going. These details relatively were of little importance. The pioneers were on their way and their collective and individual hair breadth escapes and hair raising adventures on the journey furnished sufficient excitement without considering such trifling details as the point of departure, the destination or the causes underlying the journey.

Midnight alarms, brushes with the redskins, marvelous exhibitions with the old, smooth-bore shooting irons, captures and escapes, council fires and forest lore filled the foreground to such an extent that no background was required. The pioneers apparently were equally at home in or out of the water. The manner in which they swam across the Ohio on the slightest provocation in either the winter or summer excited in my mind the deepest feeling of respect and admiration. Usually they performed the feat without even going through the preliminary detail of removing any of their clothing. Also the fact that all they owned in the world was on their backs or strapped around their waists, never deterred them from plunging into the icy current and drifting a mile or two before making land.

Invariably the hero slipped into the water without a ripple. With only his nose showing above the surface he easily and quickly made the opposite bank. Here he crawled out under a thick covering of willows which effectually concealed him from the hordes of shouting and bloodthirsty savages in the canoes. In the event that the moon was shining brightly, thus affording the savages a view of his brilliant red nose, the hero dived and made the greater part or all the remainder of the journey under water.

Basing an opinion on my own experience in the water, I was moved at times to wonder how the hero managed to breathe on these submarine trips, but after the fashion of your true hero worshipper I dismissed all heretical doubts and consoled myself with the reflection that in addition to his other endowments the hero probably was provided with gills like a fish. Doubts of youth easily are set at rest.



CHARGING TERM—HALF PIG AND HALF SCRAP

Through a combination of circumstances my little bark of life eventually floated out of the quiet eddy where I spent my early years and carried me past a considerable number of towns and cities in this northern hemisphere, including several in the vicinity of the Ohio.

Last Sunday night about 6 p. m. Bill and I left home for a short jaunt down to Philadelphia. About 9 p. m. while our train ran along one side of the river we had our first view of the long continuous line of flaming furnaces that line the opposite bank for a distance of 20 miles outside the city of Pittsburgh. I directed Bill's attention to the magnificent display and intimated it represented quite a contrast to the appearance of the old Monongahela in the days when Pittsburgh was only a frontier outpost and marked the furthest advance of the white man beyond the Alleghenies.

"I'll tell the giddy old world," said Bill. "There is some change. The breath of industry fanned the embers of old dead and forgotten camp fires into a mighty flame that has transformed the territory into the greatest of the many forges established by Vulcan in various parts of the earth.

"Among other things it is significant to note that during the past 50 years the avalanche of steel pouring out of Pittsburgh mills has created more than 2000 millionaires. A pall of smoke from a thousand great stacks hangs over the city by day and flaming bessemers lighting the valley for miles advertise it's position by night.

"Millions of tons of ore from the Minnesota ore ranges are poured yearly into the roaring blast furnaces where the dross is separated from the metal. The greater part of the iron later is converted into steel that is shipped out of the valley while the slag dump is reminiscent of the flood of lava that buried Pompeii and Herculaneum. Bessemer converters are spouting sheets of flame by day and night. White hot, sizzling steel, bubbles and boils in the open-hearth furnaces in a manner that would cause the late Mr. Dante to curl up and die of envy if by any chance he could come back, don a pair of blue glasses and peep through a test hole opening in one of the charging doors.

"Considering his limited opportunities for observation the old boy conjured up a fairly comprehensive vision of the nether regions, but Oh, boy, just think of the job he could have turned out if he actually had seen 100 tons of sizzling steel boiling on the hearth of a furnace or if he had seen a stream of the same metal bursting through the tap hole and cascading into a ladle big enough to boil a flock of elephants.

"Can you imagine the fiendish possibilities he would have seen in the soaking pits where the ingots are raised to a white heat. If he had seen these glowing lumps of steel thrown on the swiftly revolving rollers that guide them through rumbling rolls where they are squashed as readily as dough is flattened on the kitchen table.

"The huge reversing engines or giant motors drive the quivering bloom back and forth through the remorseless rolls that are brought closer together after each pass until the stout block of steel 2 feet square and 6 feet long is reduced to a size perhaps 4 inches square, 100 feet in length. I am sure he would have found endless suggestions in watching the shears chop the blooms into short lengths and in following the short pieces through other mills where they are converted into sheets, bars, rods, wire and the almost endless shapes that are called for in the

industrial life of this great nation.'

"Did you ever stop to consider," I said, "that in all the descriptions you have read of various phases of the metal industry, you have seen little or no reference to the important part bricks play in the construction and operation of the extensive equipment employed.

"Without brick capable of withstanding high temperatures, smelting or refining metals on the scale pursued today would be impossible. Every new method, every invention tending toward increasing production or decreasing costs in the manufacture of metal is hailed as something wonderful and yet the work of the brickmakers who meet every exacting requirement never is mentioned. This business of hiding one's light under a bushel and waiting for the recognition of a grateful public is altogether out of step with the catch-as-catch-can industrial life of today. I believe in giving credit where credit is due and it seems a strange thing to me that in the general distributing of medals for meritorious achievement in metallurgy, the brick makers consistently have been ignored."

"Well," said Bill, "I'll tell you. There are bricks and bricks. They range all the way from the gold brick that figured so prominently in confidence men stories of a former generation, to the humble, second-hand brick concealed in a hard hat and laid temptingly on the sidewalk on the first day of April. Every child in the country is as familiar with ice cream bricks as he or she is with the story of the bricks of Sparta.

"When the king of Sparta on a certain memorable occasion proudly pointed to his soldiers and said: 'There stand the walls of Sparta, every man a brick!' he had little conception of the important part brick was destined to play in modern industrial life. If he had been gifted with second sight to pierce the mystical veil that conceals the future he would have revised his opinion considerably on some points connected with the brick industry.

"In his day brick was considered an indestructible commodity and modern research has confirmed the view held at that time. Walled cities have passed away. Winds of the desert have covered them with sand and debris and for centuries have wailed a requiem over their one time greatness. Their inhabitants have vanished and left no more trace than the smoke from their sacrificial fires. They are gone. They are no more. Doubt that they ever existed would be justified were it not for their bricks.

"Modern archeologists delving in the accumulations of ages have discovered bricks, perfect as the day they left the ancient kilns. From the inscriptions on the surface, still sharp and clear, they have been able to visualize the habits and customs and mode of life of a people who were great and powerful at a time when the inhabitants of western Europe stained their bodies with woad in lieu of clothes and fought with the pigs in the forest for their share of the acorns.

"Burned clay bricks are used today for building and other purposes and may well be intact 1000 years from now and will furnish information to any prowling scientist curious enough to seek knowledge of present day conditions. They are not changed by fluctuation in natural atmospheric temperatures. They are not subject to corrosion in earth or water. They are destroyed only by fire, the master element from which practically nothing, organic or inorganic, is immune.

"Bricks used for the melting and refining of metal never will serve a future historian as a base on which to erect a theory. The life of a fire brick is comparatively short and usually when it has served its purpose it no longer is recognizable as a brick. Considering the severe service and high temperatures to which they are subjected, I think their action under fire is little short of marvelous. At one time the bats were discarded and helped to swell the dump at the back of the plant, but modern practice favors grinding them into a coarse powder which can be mixed with a suitable binder and used for patching and other purposes."

"If you are so deeply interested in the subject," I said, "why don't you hire a hall or something and shout the burning message so that all and sundry may grasp its significance and govern themselves accordingly?"

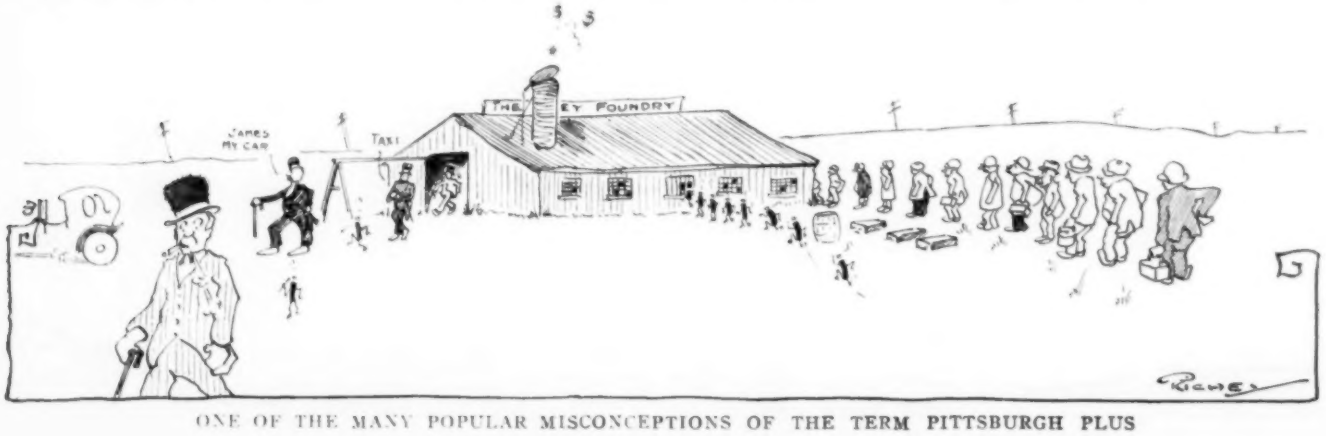
"My dear friend," said Bill, "I am afraid you are imbued with the restless spirit of the age. You seem to think everything can be done in a minute. The brickmakers gradually are coming to the point where they will be in a position to claim full recognition. According to all available records Rome was not built in a day even if the original world was made in six days. The two jobs were under different supervision. Fifty or 60 years ago if a traveler missed a stage at some little outlying western point he was content to wait patiently for one or two days for another. Today the average man lets out a squawk if he misses one section of a revolving door!"

Close Cleveland Branch

L. O. Koven & Bro., Inc. has dispensed with its office at Cleveland, and will conduct sales exclusively from the home office, 154 Ogden avenue, Jersey City. The company designs and constructs sandblast machines and special sheet steel equipment.

Boston Office Is Moved

The Boston office of the Joseph Dixon Crucible Co., Jersey City, N. J., has been moved from 49 Federal street to 80 Federal street, the new Chamber of Commerce building, room 320. The staff of the Boston office consists of H. A. Nealley, Guy W. Hart, Wm. E. Haggerty, Charles A. Shaw, R. H. Brinkerhoff and J. W. Loftus.



ONE OF THE MANY POPULAR MISCONCEPTIONS OF THE TERM PITTSBURGH PLUS

How and Why in Brass Founding

By Charles Vickers

Copper-Tin Bronze Is Acid Resisting

We are to make some heavy bronze castings which are to be placed on the top of a chimney 100 feet in height, and approximately 9 feet in diameter at the top, through the flue of which gases coming from soft coal will pass. We understand that chemical action is strong at the top of the chimney, and we would like to obtain the formula for a metal that will resist the action of the same.

There is nothing better than a good copper-tin bronze for this service but it is imperative that the castings are quite sound and free of all traces of segregation as shown by the examination of fractured surfaces. Any alloy showing a fracture that is apparently a mixture of two or more differently colored alloys, will be quite useless. An alloy that will cast without difficulty and that serves well for a bronze for resisting corrosion of any kind is found in the 90/10 alloy. It should be made as follows:

CORROSION RESISTING BRONZE

	Per cent
Copper	89.50
Tin	10.00
30 per cent manganese	.50

First run a small test heat casting a fracture test bar 1¼ x 1½ inches section and as long as thought best, 8 inches being sufficient. Nick across a wide side with a hack saw about ⅛ inch deep and break. This should show a perfectly homogeneous fracture. The reason for this test is that the melting practice is unknown to the one answering this query, and it may be that six or even four ounces of manganese copper per 100 pounds of metal will work better than the 8 ounces suggested. If no difficulty is experienced in running the alloy into the molds, by all means use the 8 ounces of manganese copper. Do not use phosphorus.

Purifying White Metals

We have on hand a batch of white metal melted from an accumulation of scrap railroad journal bearings which when remelted, persists in running porous in spite of all we can do. We treated it in various ways, such as heating a dull red, then allowing to solidify, after which it was remelted and skimmed cold. We then boiled it from the bottom using a charge of 4 pounds sal ammoniac, 2 pounds of sulphur; 1 pound of rosin and 1 pound of charcoal. We also boiled it from the bottom for periods of 10, 20 and 30 minutes using a green wood pole, and afterward we cut the surface with rosin and skimmed clean. None of these treatments has overcome the foaming or gassy condition, as the metal when poured into a bearing foams up at the top and when the bearing is broached it is found full of pinholes which spoil it for service. The analysis of this metal is as follows: Copper, 0.07 per cent; tin, 3.81 per cent; lead, 85.43 per cent; zinc, 0.03 per cent; antimony, 10.24 per cent; iron, trace; arsenic, 0.15 per cent, sulphur, 0.27 per cent.

As the metal foams when poured it would appear there is some reaction between some of its constituents and the acid flux coating the surface of the bearing. As the foaming is caused by the generation of a gas and if this occurred within the kettle the molten metal would not lie quietly, but if left molten for a time all the gas would be dissipated. The presence of arsenic alone in the metal would not give rise to a gas, and it is doubtful if sulphur alone would be responsible for gases as it is used extensively for fluxing white metals. The combination of sulphur and arsenic forms nonmetallic substances such as *realgar* and *orpiment*. The first is formed when the two elements are melted together, but it would require a considerable stretch of the imagination to blame the formation of such a body for the gaseous condition of the metal. However, it is barely possible that the combination is not good for the success of the babbitting operation.

Your treatment so far has been of a fluxing and reducing nature and it has failed. Therefore, it is possible that it should have been of an oxidizing form. Thus by heating the metal to a dull red and adding litharge, some of the impurities may be eliminated as oxides, and possibly the sulphur can be driven off as the dioxide, after which the metal should run soundly as arsenic usually is credited with assisting the soundness of white metals. In adding litharge, it is thrown on the surface of the metal which is heated until the litharge melts. It will remove antimony and the lead will be softened, but the oxidized antimony can be reconverted into the metallic form, while new metal is added to the lead as required. It might be well to have the tinned surfaces of the bearings clean of any flux before they are babbitted.

Make Copper Castings for Electrical Purposes

We would like to know how to make copper castings for electrical purposes. We have been using a mixture of 100 pounds pure copper with 12 ounces of 10 per cent silicon copper, and after melting it as advised on page 207 of the Foundrymen's Handbook we did not get good results. The castings were porous. We tried the metal exceedingly hot, then cooler and finally quite cold without success. Please advise us how we can get satisfactory results.

The failure to obtain satisfactory castings in this instance is in no way due to the instructions given in the *Foundrymen's Handbook* as they are so explicit it is astonishing that anyone could possibly go wrong. Something is radically wrong with the melting practice and we suggest this be carefully checked. Sound copper castings have been made for years by many foundries that use less than ¼ per cent silicon copper, and this small amount of silicon copper is used to get castings as high in electrical conductivity as possible.

If, after checking the melting practice, the same unsatisfactory results are obtained, the remedy is to increase the percentage of silicon copper. Probably in this case it will be necessary to add about 2 per cent to get the castings free of holes. However, such castings will possess under 50 per cent of the conductivity of pure copper.

Making a Ductile Alloy

We are making certain brass castings the design of which makes it necessary to bend them into shape after molding. Can you suggest a mixture that will be ductile enough for this purpose?

The following alloy will bend to any degree required: Copper 90 per cent, zinc 7 per cent, and tin 3 per cent. It is conveniently made as follows:

Melt together copper, 75 pounds and sheet yellow brass clippings, 23 pounds, place the brass in the bottom of crucible with the copper on top and use a deepener on the crucible to get in all the metal at one charge. Melt the metal under plenty of charcoal when the metal is all melted add 3 pounds of tin. If the castings are to be machined 2 per cent of lead also may be added to the mix and this amount taken from the copper content in making up the mixture.

PATTERNMAKER Uses Gouges for Roughing Out Work In Much Faster Time

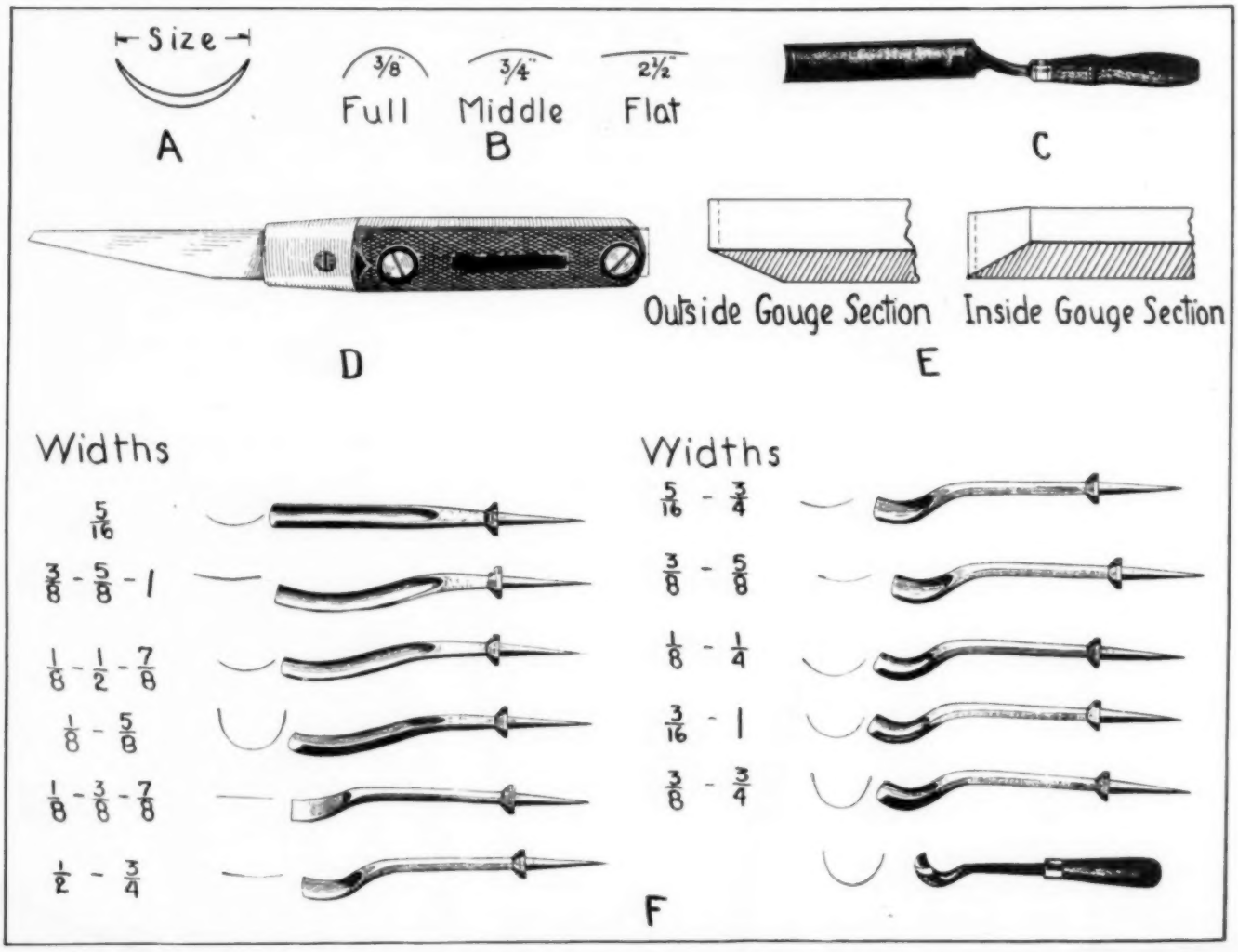
By Walter C. Ewalt

GOUGES, as the name implies, are scooping or forcing out tools, being simply bent chisels. Paring gouges are ground or beveled on the inside and are called inside gouges. Firmer gouges are ground on either side, those ground on the outside being called outside gouges. The bent shank paring gouges, as shown at *C* in the accompanying illustration are used most widely. However, outside firmer gouges should be contained in the patternmaker's kit since they may be used with a mallet, which sometimes is necessary when working with hard woods. The method of determining the size of the tool is shown by *A*. Gouges are made in three sweeps, namely regular or full, middle and flat. A ¾-inch gouge of the different sweeps is illustrated in *B*, the figure below indicating the radius.

The bent shank gouge has the handle raised about the line of the bottom of the blade, the handle also being at an angle with that line. The offset allows the worker to grasp the handle so that the hand will not come in contact with the wood when it is necessary to continue into the wood beyond the handle, as, for example, in gouging out a corebox 24 inches long.

A gouge is a most useful tool for roughing out work, both inside and out, with or across the grain and across end grain. Faster work may be done with it than with a chisel. This is due to the fact that the edge meets the different kinds and textures of the grain, and because a shearing cut, especially across the grain, may be made by revolving or twisting the blade on its axis. Usually the outside edges of the blade are even or above the surface of the work and it is not necessary to force the wood out of the way, as in the case of the chisel.

The angle to which the gouge is ground varies according to the conditions which were mentioned in the article on chisels which appeared in the Feb. 1 issue of THE FOUNDRY. The ouside gouge may be ground with a



A—DETERMINING THE SIZE OF THE TOOL—*B*—¾-INCH GOUGE OF DIFFERENT SWEEPS—*C*—BENT PARING GOUGE—*D*—PATTERNMAKER'S KNIFE—*E*—DANGER OF ROUNDING THE EDGES OF THE TOOLS WHEN SHARPENING—*F*—CARVING TOOLS THAT ARE USEFUL TO THE PATTERNMAKER

slightly thinner edge, but care should be exercised not to burn or grind an excessive feather edge. It may be rough ground on a wheel having a rough edge, or on a cone wheel screwed onto the spindle of a lathe. The tool then is sharpened with an oil stone slip, care being taken not to make the bevel rounding by rocking the slip. The gouge is held in the left hand, and the slip, which has been supplied with good oil, in the right hand. Shorter strokes will assist in preventing the rocking motion. The flat side of the slip is used to take off the feather edge on the outside. The outside surface must be straight, since this side helps to guide the gouge. The outside gouge is ground on a flat-face wheel by revolving the handle so as to bring all of the curved surface against the stone. Greater care should be exercised in the grinding of this gouge as only a small amount of the blade is against the stone at one time which may cause the blade to burn or to have a long feather edge.

The flat side of the slip generally is used to finish sharpen and the round edge of the slip is used to take off the feather edge on the inside of the gouge. Care also must be taken not to rock the stone when sharpening the inside gouge and form two angles, as shown at E.

While a list of patternmaker's tools was published in the Feb. 15 issue of THE FOUNDRY, the addition of a few paring gouges of middle and flat sweeps will be found convenient. It hardly is necessary to add that gouges should be kept sharp if the best work is to be obtained.

The 12 carving tools included in the list required by the patternmaker are shown at *F*. As the tools vary in width, the worker must be governed in his selection by the type of work to be done. The sizes given are merely a guide and were picked from a patternmaker's kit. It also may be noted that the carving tools are forms of chisels and gouges and are adapted especially to working out odd shapes in wood. There are many varieties of carving tools manufactured, both in sweeps and in widths, but the types shown in the illustration should be sufficient for ordinary jobs. In fact more are shown than are found in many patternmaker's kits.

Particular care must be taken in grinding and sharpening the carving tools, even more so than with straight gouges, since the more they are sharpened the shorter they become, and the less efficient they are. This is due to their shape. The tools are sharpened in the same method as gouges. They are used in many places including working out inside fillets, the inside of coreboxes.

A patternmaker's knife is shown at *D*. The blade and the handle may be purchased separately. The blade slips through the handle and is fastened with a screw in the ferrule, the dimensions being 9/16 x 6½ inches. As the end of the blade wears down, the screw in the ferrule is loosened and the blade shoved further out. As this is continued, the blade becomes too short and another full sized blade is inserted. The handle is made of aluminum with hard rubber sides.

The principal use of this knife is in laying out a pattern on the layout board. Both cross and end grain lines are marked with it, greater care being exercised in making lines with the grain since the knife may follow the grain. For this reason the first line is made light.

The knife makes a finer and smoother mark than the scratch awl. Often, after the line has been made with the knife, a hard, sharp pencil is drawn along the line making it more discernible. The knife also is used for many other purposes in making patterns, such as rounding corners, etc.

A knife is ground on both sides and makes a true wedge. However, unlike other tools which are in the shape of a wedge, such as the cold chisel, and which are driven straight into the work, the knife is used in such a way as to make a shearing cut. As explained in the article on chisels, a wedge shaped tool is difficult to guide straight and this applies to a knife. The bevel should be the same on both sides and a more acute angle given to it than to an ordinary pocket knife. The change in angle may be made since more care is taken in the use of the knife and the patternmaker does not use much force to curl or pry up shavings. The cutting edge of the knife is broken off if much force is used.

STAND PAT ON PRICE

BY H. P. KELLER

Most foundrymen have indulged in idle speculation as to the ultimate distination of the foundry business. When in a confidential mood, any foundryman, will says that the business from time immemorial has been fraught with grief. Today, while it is not all that may be desired some improvement may be found. Likewise he is aware that competitors are out gunning for the orders that he would like to secure.

Though the foundryman may manufacture what he considers the best castings in appearance as well in texture of metal, there is one final court from which apparently there is no appeal. It is that of price. The slogan of the buyer seems to be—"price first and quality second". Happy is the man who can produce castings at a price and still not jeopardize his reputation for quality. However, that is the situation that confronts the foundryman today and he is making a noble effort to cope with it.

A thorough and accurate cost system at this time is one of the most valuable assets in the busines. It enables the sales manager to quote prices intelligently rather than in a haphazard fashion. The cost system is a record of the manufacturing costs in the past.

The opportunity comes to bid on a choice run of work. Can the foundryman apply the unit costs of past experience to the qoutation on this new work? Decidedly not as a whole. Here is where a good cost system is of investiable value. By a good cost system is meant, one in which the overheads are divided in such a way that the fixed overheads and the variable overheads will assume their proper ratio at certain fixed tonnages. In this connection it has been found practicable to work up a set of tentative unit costs at the desired tonnages. In this way a fair price is determined for any quotation desired, according to the volume of daily or weekly production.

By the application of a system as outlined, the foundryman is prepared at all times to make equitable prices on any volume of work, regardless of the production condition in which he temporarily may find himself.

One of the dangers that should be borne in mind, is the effect of indiscriminate price cutting on future prosperity. Often in the anxiety to secure a certain order, discretion will be thrown to the winds and a price quoted which, in saner moments will be realized as ridiculously low. Remember, a precedent may be established and at a future date the foundryman may be forced to ask a higher price.

Most foundries have fixed prices for customers over specified periods. A customer occasionally will try to take advantage of an apparent need for work and will ask a special low price on certain runs of castings. Usually it is a foolhary policy to accede to such a request, as the fixed price he enjoys probably covers many classes of castings, light and heavy and with varying core burdens. Were each job to be analyzed separately, the results may not be as satisfatcory as the foundry-

man might think. Still, when the customer gets a run of work which may be desirable, he wants a special quotation. There is only one suitable treatment for a customer of this kind—Stand pat on price for, if not, soon all of his work will be made at a special price. Theoretically the arrangement should be, a separate price for each piece, based on its merits, though for practical purposes this is not always desirable. Foundrymen will do well to give the stand pat on price policy a little thought.

To Study Metals at High and Low Temperatures

Research on the properties of metals at extremely high and low temperatures is to be undertaken by a joint committee from the American Society of Mechanical Engineers and the American Society for Testing Materials. Little authentic information on this subject now is available. Objects of the new research committee will be to accumulate existing unpublished data on the subject; to make studies leading to standardization of the procedure for listing materials at high and low temperatures and to outline and foster new research work in this field. George W. Saat'hoff, chief construction engineer, Henry L. Doherty & Co., New York, is chairman of the joint committee. Other members are George K. Elliott, Lunkenheimer Co., Cincinnati; H. J. French, bureau of standards, Washington; John B. Johnson, army air service, McCook Field, Dayton, O.; V. T. Malcolm, Chapman Valve Mfg. Co., Indian Orchard, Mass., John A. Mathews, Crucible Steel Co. of America, New York; and LaVergne W. Spring, Crane Co., Chicago.

Talks to Foundrymen

Business cycle analysis and the anticipation of production schedules are applicable even to the small foundry according to Joseph H. Barber, the Walworth Mfg. Co., Boston, who spoke before the regular February meeting of the New England Foundrymen's association recently on the subject of "Stabilizing Production and Profits." Following Mr. Barber's talk Harold Mills of the Metropolitan Life Insurance Co., spoke on insuring thrift in industry.

O. P. Henchette has been appointed sales engineer for the Burke Electric Co., Erie Pa., in charge of the Cleveland office, 7829 Euclid avenue.

Complete New Plant

The Kwik-Mix Concrete Mixer Co., Milwaukee, has completed its new plant at Port Washington, Wis. The building is of brick and steel, 60 x 120 feet, and adjoins the old plant, which now will be used as a warehouse and shipping room. The concern also maintains a foundry in Fredonia, Wis., where all castings are made and the small mixers of the line are built complete.

The Port Washington plant has a capacity of five large size mixers a day. An office has been opened in New York for export trade and heavy shipments have since been made to Porto Rico, Cuba and Japan. John Gilsen is manager of the Port Washington plant and supervises the Fredonia works as well.

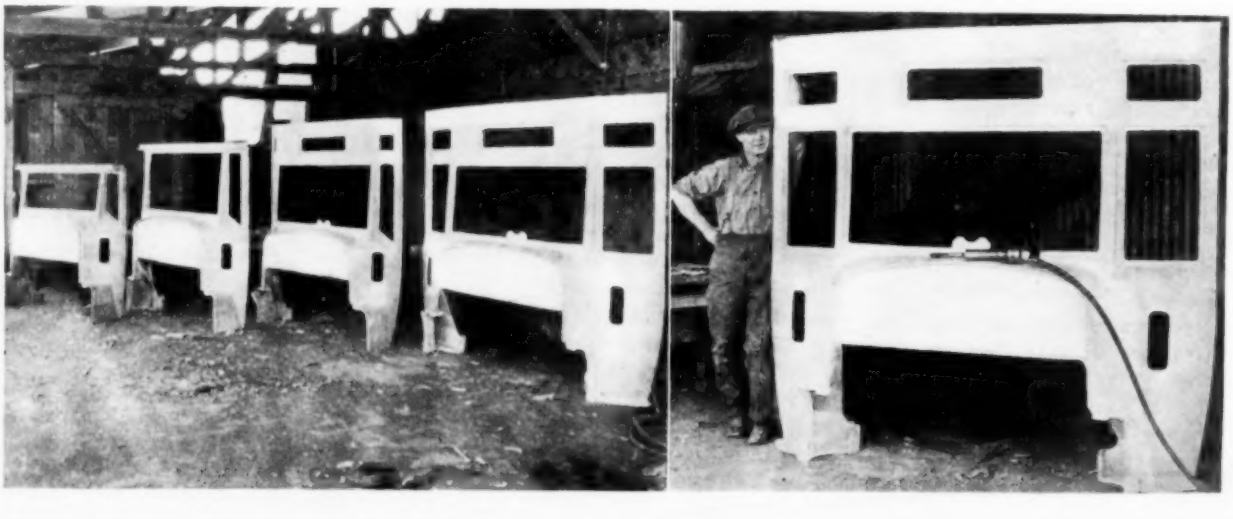
Brass Plants Merged

Merger of the Standard Brass Works and Peninsular Brass Works, Detroit, has been announced, the new company being the Standard-Peninsular Brass Works. F. G. Austin is chairman, H. R. Brownell president, P. E. Welton, vice president and C. L. Parsons, secretary and treasurer.

LARGE ALUMINUM CASTING MADE ON PRODUCTION BASIS

CONTINUAL increase in the size and capacity of passenger buses and trucks has developed a need for methods of keeping down the total weight of the machine. This is accomplished in some designs by using aluminum for such parts as cowls, brakeshoes, window frames, etc. The large aluminum casting shown in the accompanying illustration is one of the largest manufactured on a production basis, and is made by McKinney & Spies, Alameda, Cal. The casting combines both cowl and windshield and has provision for door hinges, brackets, fenders, etc.

The large casting, which is shown at the right, is 84 inches high, 79 inches wide and weighs 240 pounds. The smaller casting measures 59 inches in height, 64 inches in width and 16 inches in depth, the weight being 118 pounds. No. 30 alloy prescribed by the American Society of Automotive Engineers and made of pure aluminum with a copper hardened ingot and then recast, is used in making these castings.



Ask What Is Wanted

In Foundry Refractories

American Ceramic Society Brings Users, Scientists and Producers Together To Study Cupola, Air Furnace, Open Hearth and Electric Furnace Requirements

RECOGNITION of the pressing character of foundry refractory requirements led the American Ceramic society to arrange a special symposium held Wednesday, Feb. 18 during the annual convention of the Ceramic organization at Columbus. This session was attended by about 50 foundrymen, and the American Foundrymen's association committee on refractories, in addition to technical men, producers and manufacturers. The case for the user of cupola refractories was presented in papers by Dr. Richard Moldenke, Watchung, N. J., and James T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala.

George A. Bole, bureau of standards, Columbus, who presided at this session focused the discussion by remarking on the mutual ignorance of foundrymen and refractory producers alike as to what constitutes good practice. Manufacturers deplore the tendency of foundries to buy only one class of refractory and attempt to use it for all service. The case of $45 cupola blocks used for ladle linings where a $28 product would give better service was mentioned. Further, one type of block commonly is used both for the cupola area above the melting zone where resistance to shock and abrasion is paramount and for lining the furnace at and below the melting zone where slag action and high temperatures require an entirely different product.

H. A. Schwartz, National Malleable & Steel Casting Co., Cleveland, in a brief summary of the malleable industry's need mentioned the difficulties encountered in air furnace practice. This paper is abstracted in the following article.

In the discussion following Mr. Schwartz' paper one large manufacturer operating many air furnaces recommended a 21-inch side wall constructed of fine-ground soft-burned refractory blocks. A large bung block was recommended, since the reduction of joints tends to minimize trouble due to spalling.

Open-hearth furnace requirements were outlined by Prof. Dana T. Demorest, Ohio State university, Columbus, who cited a foundry open hearth furnace in Columbus which has operated continuously for a year without a roof replacement. This long life is ascribed to the use of machine made brick, closely and accurately laid with exceedingly thin joints. Mr. Demorest recommended grinding brick together in laying them, particularly about the outlet ports. He stated further, that dolomite makes most satisfactory basic bottom as it resists the penetration of iron oxide. He recommended the use of chrome ore along the side walls and ports to increase the life.

The technical sessions of the society were grouped under the headings of art, enamel, glass and refractoies. At the annual banquet held Tuesday, Feb. 17, it was announcd that Dr. E. Ward Tillotson, Mellon institute, Pittsburgh, was elected president and Frederick Rhead, American Encaustic Tiling Co., Zanesville, O., vice president. Ross C. Purdy, Columbus, is secretary of the association. The next annual meeting will be held in Atlanta, Ga.

States Malleable Refractory Needs

By H. A. Schwartz

IN THIS paper prepared for the annual meeting of the American Ceramic society at Columbus, O., Feb. 17-18, the author, H. A. Schwartz, director of research National Malleable & Steel Casting Co., Cleveland, outlines the refractory requirements of the malleable industry. He says, in the present state of the art it is probable that the ceramist's efforts may be most profitably applied in improving the resistance of side wall brick to the chemical action of slags and of bung brick to mechanical destruction by thermal stresses and the stresses applied by the bung frame.

AIR furnace melting presents combustion conditions, such that the final products will contain little, or no free oxygen, and a few per cent of carbon monoxide. The reason for this requirement is deeply rooted in the chemical equilibria between the gas and liquid phases in contact in the furnace. It is not capable of modification for any purpose whatsoever.

Under these conditions, the maximum flame temperature is possibly 3200 degrees Fahr., as actually measured in commercial furnaces. The temperature of the face of the furnace walls will be that at which heat input, by convection mainly, is balanced by losses by conduction outward and radiation from the furnace structure. This means in practice, perhaps 3000 degrees Fahr., the resulting metal leaving the furnace at temperatures about 2600 degrees Fahr.

If the thermal engineer seeks to minimize radiation loss by using extra thick walls, the inner face of the wall grows hotter, since the cooling action of the furnace exterior has diminished. He buys fuel economy at the expense of refractory economy.

In furnace roofs or *bungs*, a thickness of 4½ inches is almost the universal standard. Probably this has been determined as the best balance between brick, labor, and fuel economy. In side walls, thicknesses from 18 to 9 inches are in use. The former fail, in the beginning, quite rapidly. Probably 9-inch walls would be ideal if it were nto desirable to

break joints at least once in the thickness of the wall. As a matter of fact, were it not for the mechanical instability of thin walls, a thickness of from 4½ to 6 inches might be maintained indefinitely by some method of exterior cooling.

The best economy in both fuel and brick, was obtained on furnaces with 12-inch walls. Heat insulation would seem to hold out no promise of merit, for it would result, probably, in the rapid destruction of the inner refractory linings. The heat capacity of furnace structures is also of importance. The conductivity of clay refractories is not so great but that considerable time elapses before they reach their final equilibrium temperatures. If the structure be allowed to cool over night, they actually will not ever reach equilibrium in service, and hence, will survive more hot hours than when continuously operated. Air furnaces operated 24 hours a day have required major repairs in less than a week, while, when operated 16 hours a day, they would require much less repair after two weeks.

Abrading Flames

Erosion by flue gases is an important source of wall destruction. The flame must move sufficiently rapidly through the hearth to produce the circulation in the bath required for quick heating. It carries with it a spray of slag and iron particles, which flux the roof and walls and the friction of the hot gases drags this softer material off and carries it along. Wherever constrictions occur, or parts project sharply into the stream of gas, rapid cutting occurs.

Most furnaces use *top blast* and if these streams of air are so directed as to strike a wall, the brick is rapidly cut out by a combination of melting and erosion.

Somewhat fantastic roof forms were formerly rather common, and it was also thought that the top blast would force the flame away from the roof. It is doubtful whether either arrangement has any merit whatever, and a roof which in profile is nearly straight, but dips down toward the stack is the most suitable.

The character of the fuel is important. Most air furnaces are grate fired, using forced draft. Most coals, so fired, blow particles of coal, coke and ash up into the gas stream, which impinge on the roof over the fire box. Depending on the character of the ash, it may flux the brick and cause roof failure, or it may stick as a spongy mass, and protect it.

Coal also differs in the time required for its gaseous decomposition products to unite with the air supply. If this time be short, a high temperature may be realized before the gases strike the fire-box roof, and much damage done. It is one of the functions of the top blast to avoid the possibility of complete combustion, and hence maximum temperature, occurring before the flame has come into contact with the charge. With pulverized coal there is an advantage in that the burning mass travels always along the length of the furnace, and need not impinge on the walls or roof at its point of maximum temperature.

In the early days of oil burning, such hot localized flames was destructive to brick work, although in later installations this largely has been overcome. There is now a distinct feeling that both pulverized coal and oil are less destructive to furnace linings than is hand fired coal. Whether the point is capable of rigid proof is somewhat doubtful. Some indirect effect through chemical action may also be expected, for any system which uniformly regulates the combustion, will avoid accidental over-oxidation of the charge. The products of such oxidation are destructive to clay brick.

The author has in the past touched upon the chemical action of slags. During the progress of each heat the slag changes progressively from molten Fe_2O_4 to acid ferrous silicate, resulting in a serious problem to the ceramic chemist, who wishes to minimize its fluxing action on his product.

In furnace roofs we are confronted with mechanical difficulties. Too round an arch results in an unfavorable flame distribution, too flat a one imposes too high stresses on the *bung frame*.

Prolongs Life of Bungs

The life of bungs is enormously influenced by their mechanical rigidity. It is within knowledge that a mechanically more stable design more than doubles bung life. Bungs are used 9, 13, 18 and 24 inches wide. Where crane service is available the 24-inch bung is much the most economical, although the 13-inch size, is, perhaps, the commonest. Only considerations of the weight which can be handled without abuse should limit bung width. If the brick are to be held firmly, they must be strong; not cracking under pressure. As variations of temperature are unavoidable, they must resist this condition.

Plants Show Decrease

In 1921 the plants primarily engaged in the manufacture of foundry and machine shop products were 9013 according to the department of commerce. The decrease to 8532 in 1923 was due in part to changes in character of products. A number of plants were idle or out of business in 1923. However, the total includes a number which are new to the census.

Facing Sand for 4-Foot Cast Iron Bowl

Question: What is the most suitable facing and how is it mixed for a cast iron bowl 4 feet diameter, 1-foot deep, 1-inch metal thickness, to be molded with the convex side in the cope.

Answer: If there is no compelling reason why you should mold the casting in the position indicated we should suggest that you mold it the other side up, that is with the convex side in the drag. This is the invariable custom of all southern shops making sugar kettles of the size indicated. Theoretically, it is reasonable to infer that the bottom of a kettle poured in this position will be solid and free from imperfections to a greater extent than one poured in the opposite position. The fact that this custom prevails in shops making kettles by the hundred, indicates that the theory has worked out in practice.

The job can be molded as fast one way as the other, but a special cut out follow board is required where the casting appears entirely in the cope. Any flat board will serve as a rollover board where the casting appears in the drag. The upper side of the cope bars may be dished to a considerable depth where the casting is made in the drag and in this manner, less sand will be required to fill the flask. Whether the casting is molded up or down, the flask and bars are made to fit closely, sand containing a good bond is employed and therefore, it is not necessary to use any gaggers. Again it is well to remember that iron runs more readily down than up hill and castings that are subject to cold shuts when the iron has to travel up, will be free from that and other allied forms of imperfections where they are poured down.

A suitable facing sand may be prepared from a half-and-half mixture of old and new sand with an addition of coal dust in the proportion of 1 part of coal dust to 8 parts of sand. If the castings are to be cleaned by sandblasting the mold will require no further treatment, but if the castings are to be cleaned by hand it will be necessary to brush the surface of the mold with a good grade of blacking.

Appointed Manager

Frank J. Ross has been appointed branch manager at Milwaukee for the Federal Foundry Supply Co., Cleveland. Mr. Ross for the past 17 years has been manager of the western division of the Dominion Foundry Supply Co., Toronto.

The name of the Adrian Steel Casting Co., Adrian, Mich., has been changed to the Adrian Casting Co. The company makes gray iron and semisteel castings.

Milestones in Foundry Progress

As Recorded in the March Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

1895

CRUCIBLES, their manufacture and use, formed the topic of the leading article in The Foundry of March, 1895. The information presented was secured through Robert J. Taylor & Son, Philadelphia, a manufacturing interest which has passed out of existence. The United States mint was melting more than 5000 ounces of gold in a single crucible or, as Mr. Taylor told the writer, "nearly the weight of two barrels of flour."

* * *

What a dry comparison! Why not as much as two barrels of beer, for instance.

* * *

W. W. McCarter, foreman of the Glover Machine Works, Marietta, Ga., supervised the production of a nine-foot mortise wheel.

* * *

Mr. McCarter will be remembered by the readers of the early issues of THE FOUNDRY, *as a prolific writer on shop subjects.*

* * *

The foundry of the Pennsylvania railroad at Altoona, Pa., the training ground of such outstanding figures as Edgar A. Custer, H. H. Stone and A. H. Maxwell was described.

* * *

I have always believed that there is a lot of good common sense laying loose around our foundries, but judging from the way I have seen test bars cast * * * * *I have greatly overestimated the amount.*

KRANK'S KORNER.

* * *

No. 2 foundry iron was bringing $9.75 to $10 and large spur and bevel wheels 2½ cents a pound in Pittsburgh.

* * *

James Chalmers in his memoirs as written by W. Edward told of various troubles following which he landed as a hobo in Marshall, Tex. He noted that Robert E. Masters, a practical molder with considerable executive ability, was in charge of the shop. Masters, as an incentive to the men to keep themselves neat had cupboards with padlock and key, provided for protection of their outer clothing during working hours.

* * *

Imagine the effect some of the modern comfort features such as locker rooms, showers, etc. would have had upon some of the old time hobos like "James Chalmers." Some of the old time molders, referred to as 15-minute eggs were reputed to have shaved with No. 6 emery cloth, if ever.

Faked Foundry Facts

Rat Tails

1905

CHARLES VICKERS, reminiscent of a foundry comparable with the Dismal Swamp foundry, told of a lighting system consisting of coal in a covered pit, fired by the first iron and the gas ignited at the end of an outlet pipe to furnish illumination. A similar old time rig was described by Robert E. Masters in the issue of Feb. 1, 1925.

* * *

It is stated that in ancient Rome, the foreman of the Forum Foundry Co., Appian Way and Circus boulevard, was pouring off a floor of frames for lyres, the type of ukelele made popular by the musical emperor, Nero. The shop was dark, so a young lad recently from the training school, suggested a modified gas lighting system similar to that decribed in the preceding paragraph. This young man, named Israel was originally an immigrant from Judea, and thus originated the expression, **Israel Light.**

No. 2 foundry iron was selling for $16 at the furnace. Railroads were placing large orders for castings.

* * *

The Whitechapel Bell Foundry in England was casting eight new bells for Rochester cathedral, weighing nearly four tons. Part of the metal was provided by old bells remelted. This foundry, which was established in 1570, recently was given the contract for the peal of bells for the Lincoln memorial building in Washington.

* * *

The Cleveland Foundry Foremen visited the plant of the Berkshire Mfg. Co. of that city and studied the molding machines of the company and also some of those devised by Mr. Wadsworth, Falls Rivet & Machine Co., Cuyahoga Falls, O. W. H. Nicholls was secretary of the foremen's organization.

* * *

James A. Murphy, the sage of Hamilton, O. described a whiskey bottle cupola. A constricted area in the stack above the charging door was supposed to conserve heat. The natural result was that the flames and gases sought the easier outlet through the door to the charging floor.

* * *

Couldn't they run the blowers backward while charging, Jim?

1915

JOHN DEERE & CO. has just completed a new foundry at Moline, Ill., which was noteworthy for the two level arrangement with the molding floor above the cleaning and sand conditioning departments. An article written by J. F. Ervin, foundry engineer of the company was featured in the March, 1915 issue of THE FOUNDRY.

* * *

The Burr Co., Champaign, Ill., was reported to use ground manganese ore in its cupola mixture making semisteel.

(*Concluded on Page* 209)

The Shakeout

A. O. BACKERT, Editor
DAN M. AVEY, Managing Editor
PAT DWYER, Engineering Editor
CHARLES VICKERS, Nonferrous Editor
GEORGE A. DRYSDALE, Metallurgical Editor
FRANK G. STEINEBACH, Associate Editor

¶Castings Ease Woman's Work

RAPID advances in the use of electrical household appliances in the past 10 years have developed new demands for both ferrous and nonferrous castings. Trade estimates for 1924 place the total sales of appliances, fixtures and other electrical merchandise by retail consumers, as contrasted with commercial and industrial users, at well over $1,000,000,000.

The electric fan opened the field for modern domestic appliances. Its simplicity of operation and dependability popularized the use of electricity in the home. Today, the electric iron is far in the lead among the appliances used, the vacuum cleaner being second and the fan third. A large percentage of the parts used on all of these devices are made in the foundry.

ECONOMIC and industrial changes affecting the average home are responsible for the gain in sales. A greater demand for domestic servants coupled with the general shortage caused by restricted immigration, has caused housewives to turn to electrical appliances for domestic service. The rapid growth of cities, where electrical energy may be had at relatively cheap rates, also has assisted in creating the demand.

However, the heavy volume of sales has far from exhausted the market. About two-fifths of the population of the United States use electricity for lighting purposes. As the use of this commodity increases, as methods are developed to supply electrical energy to the farming population at costs which are not prohibitive, the use of domestic appliances will increase, and the foundry industry will profit through greater markets for its products.

¶First Know Thyself

IN SELLING castings, price apparently is of paramount importance to the buyer. This should be altered. The one selling the castings should be able to expound his product from the standpoint of quality and superior workmanship.

To do this successfully necessitates confidence in the product with a knowledge of the different processes involved in its production. The seller should familiarize himself with the practice in molding, alloying, casting and cleaning. He should place such knowledge of his products before a prospective buyer in an interesting and intelligent manner. He should convince the customer that quality and uniformity are more important than the price.

A question has often been asked of those who sell castings. "Why should we pay a higher rate for your product than we now are paying or have been offered?"

A SOFT answer which oftimes brings home the bacon, to scramble two epigrams, may be made by explaining to the prospective buyer the advantages of uniformity and quality of product which is maintained only by rigid specifications covering the ingredients used, physical properties, workmanship, size and finish. Create a favorable impression in the mind of any well informed and careful purchaser of castings, and if a sale is not made then, the ground is prepared for a future contract.

¶Speaking of Chestnuts

UNDER the spreading chestnut tree the village smithy stood for many years while the gentleman with the large and brawny arms operated his heavy sledge with measured beat and slow. He fashioned many things out of iron including the horse shoes so essential to the well being and comfort of the principal prime mover of Longfellow's day. The smith was known to every man, woman and child in the community and was regarded with esteem and admiration.

Times have changed. The chestnut tree and the village smithy have been replaced by a concrete garage and filling station where the ubiquitous motorist may receive first aid and a supply of gas and air to take him on his way.

THE present day smith uses a trip hammer to knock down his stock, or gets it in ready made shape from the mill. In the comparatively few instances where a sledge hammer is necessary, it is wielded by a helper while the smith correctly raps out a musical accompaniment on the anvil with his hand hammer.

Horse shoes are made on a machine that will turn out more shoes in a day than the old village smith could make in a life time. One famous old Pittsburgh plant is credited with a capacity of 22,500 tons of horse shoes a year.

Marked hostility was displayed toward the first machine-made steel horse shoes. Steel castings met with even a more chilling reception when first placed on the market. Steel horse shoes now are used exclusively and have been used exclusively for many years. Who knows but some day steel castings will replace all others.

Trade Outlook in the Foundry Industry

NO SWEEPING generalities can be stated to cover the condition of business among foundries at the present time. Operations vary with the changing fortunes of those industries which contribute the orders. Among automotive shops, the variation is most apparent. Those foundries which are identified with a few of the manufacturers that are moving their cars are fairly busy but in the main, auto castings are not strongly in demand. Jobbing foundries, always are subject to the ups and downs of their specialties and at present the trend has been largely on the decline with only a few noteworthy exceptions.

Make Haste Slowly

The loud chorus of cheers heard in anticipation of prosperity about the first of the year has dwindled to a few faint cries. This condition is discounted by business analysts, who point to the general improvement in basic conditions. Individual foundries will affirm that their orders are poor, that they have to dig for business and that competition never was more severe. Nevertheless comparisons in individual instances with their state of operations during the past fall bring out the fact that November showed a decided improvement. The present state of castings demand is improving, although not yet equal to that rather exceptional month. Wholesale prices are advancing, a condition which never is encountered during or on the approach of a period of depression. The railroads report unprecedented freight loadings, with a decrease in the surplus of freight cars. Bank clearings, wholesale commodity sales, mail order shipments, decreasing unemployment and stiffening wage scales all point to the gradual, but undoubted improvement in practically all lines of business. Any pessimism evident is the result of slow arrival rather than the recession of the promised prosperity.

Prices for Raw Materials for Foundry Use

CORRECTED TO FEB. 24

Iron		Scrap	
No. 2 foundry, Valley	$22.00 to 22.50	Heavy melting steel, Valley	$18.75 to 19.25
No. 2 southern, Birmingham	20.00 to 22.00	Heavy melting steel, Pitts.	19.00 to 19.50
No. 2 foundry, Chicago	24.00	Heavy melting steel, Chicago	17.75 to 18.25
No. 2 foundry, Philadelphia	24.63 to 24.76	Stove plate, Chicago	17.00 to 17.50
No. 2 foundry, Buffalo	23.00	No. 1 cast, Chicago	20.00 to 20.50
Basic, Valley	22.00	No. 1 cast, Philadelphia	19.00 to 20.00
Basic, Buffalo	22.50 to 23.00	No. 1 cast, Birmingham	17.00 to 17.50
Malleable, Chicago	24.00	No. 1 cast, Buffalo	18.00 to 18.50
Malleable, Buffalo	23.00	Car wheels, iron, Pittsburgh	19.50 to 20.00
Coke		Car wheels, iron, Chicago	19.50 to 20.00
Connellsville foundry, coke	$4.25 to 4.75	Railroad malleable, Chicago	20.00 to 20.50
Wise County foundry, coke	5.00 to 5.50	Agricultural, mal., Chicago	18.50 to 19.00
		Malleable, Buffalo	19.50 to 20.00

Steel Mills Active

Perhaps the greatest outstanding example of activity at present is the steel industry. Rolling mills are exceedingly busy, and the ingot output in January approached within 4 per cent of the highest total ever recorded. January showed an increase of 13.3 per cent over December and the increase since the low point last July was 115 per cent. This condition is reflected by the state of operation among roll foundries. These are operating full time, and the output is moving steadily, allowing no chance for accumulation of stock. The same situation is found among ingot mold shops, those devoted to heavy steel mill machinery and even down to the nonferrous foundries making roll housing brasses, copper blast furnace tuyers and sundries. General machine tool business shows improvement and the outlook for spring is considered favorable by machine tool manufacturers. Sales of small hand tools are excellent, and have shown a steady improvement for the past several months.

Railroads Buy Again

After a lull during January the purchases of railway freight cars again are increasing. The total for January was only 1685, while the first two weeks of February more than doubled this total. Bookings of steel castings for January continued heavy, although slightly below the preceding month. According to the department of commerce, the total orders for steel castings during January represented 82.6 per cent of capacity, compared with 95.8 per cent for December and 73.9 per cent for November. This is in line with the general situation previously mentioned. Railway specialties showed 94.9 per cent of capacity for January compared with 124.0 per cent for December and 96.1 per cent during November. Miscellaneous steel castings held more steady during the three months in question, January showing 73.4 per cent, December 74.6 per cent and November 57.3 per cent. These figures are based on the reports of 68 identical companies, representing a monthly capacity of 100,400 tons. A greatly increased demand is noted for oil refinery and pipe line service. The former class of service is demanding steel valves to be used under high temperature and with high pressure. Freight car loadings presage continued heavy car purchases. The first five weeks of 1925 surpassed all previous records in the number of cars loaded. The total was 4,450,993, according to the American Railway association. The total given is 3 per cent above the similar period last year. The railroads have authorized the expenditure of $1,100,000,000 during 1925 for improvements and betterments. Building construction is going ahead in a satisfactory manner. The awards in 27 northeastern states totaled $255,367,000 during January, according to the department of commerce. This is slightly lower than the same month last year, but 1924 was an exceptional year in building construction. Commercial structures take the lead over residence and factory building.

Nonferrous Prices

New York prices for nonferrous metals, according to the *Daily Metal Trade* of Feb. 24, follow: Casting copper, 14.25c; electrolytic copper, 14.75c; Straits tin, 57.12½c; lead, 9.15c to 9.25c; antimony, 20.00c; nickel, 38.00c; aluminum, No. 12 alloy, remelt, 22.50c to 23.00c. Zinc is 7.62½c, E. St. Louis.

Comings and Goings of Foundrymen

O. K. CARPENTER has become general manager of the Blackwood Electric Steel Corp., Parkersburg, W. Va. He previously had been with the Eastern Steel Castings Co., Newark, N. J., leaving that organization to assume his new position with the Blackwood company Jan. 1. Mr. Carpenter started in the steel foundry of the Ohio Steel Foundry Co., Lima, O., in 1909, leaving in 1913 to join the Bayonne Steel Castings Co., Bayonne, N. J. He left there in 1918 going with the Reading Steel Casting Co., Reading, Pa. After a year there he returned to Bayonne in the sales department, leaving that company after six months to become superintendent of the Millbury Steel Foundry, Millbury, Mass. At the end of the year he became superintendent of the New England Steel Castings Co., Springfield, Mass. After a bad fire in the New England plant, Mr. Carpenter returned to the Bayonne company in the fall of 1912, as general superintendent. When the company was reorganized as the Eastern Steel Castings Co. and moved to Newark, N. J., he was placed in charge of fitting the new plant for operation.

Elbert Mueller has been elected president and general manager of the Mueller Iron Foundry Co., Detroit.

John V. W. Reynders has been elected president of the American Institute of Mining and Metallurgical Engineers at the convention in session at New York, Feb. 16 to 19.

J. W. Hildebrand formerly connected with the W. A. Jones Foundry & Equipment Co., Chicago, has joined the sales force of the Foote Bros. Gear & Machine Co., that city.

Marshall Post, former manager of the American Steel Foundries plant at Sharon, Pa., has been named general manager of the Birdsboro Foundry & Machine Co., Birdsboro, Pa.

Albert G. Wessling has been elected president of Wessling Bros. Foundry Co., Cincinnati. George W. Piehl is vice president, Henry J. Weber, secretary and Robert L. Kruse, treasurer.

Marshall Post, former manager of the American Steel Foundries plant in Sharon, Pa. has been named general manager of the Birdsboro Foundry & Machine Co., Birdsboro, Pa., Mr. Post recently has been manager of the plant at Chester, Pa., for the American Steel Foundries.

H. Cole Estep, vice president, Penton Publishing Co., Cleveland, addressed the Detroit Foundrymen's association at its meeting Feb. 19 on economic trends as related to foundry operation.

John Gaillard has resigned as a staff engineer of the American Engineering Standards committee to take charge of the technical standardization work for the various plants of the American Radiator Co. S. J. Koshkin, former associate editor of the American Machinist, will take over Mr. Gaillard's works.

R. J. McSherry has been made foundry superintendent of the Oliver Chilled Plow Works, South Bend, Ind. Mr. McCherry recently was connected with the Hillside Fluor Spar Mines, Chicago, and previously was foundry superintendent of Hercules Corp., Evansville, Ind.

O. K. CARPENTER

Stanhope Boal, president of the Favorite Stove & Range Co., Piqua, O., has resigned to become chairman of the board of directors. Mr. Boal has been connected with this company for 52 years. He will be succeeded by J. A. Underwood.

Frank D. Chase, Chicago, spoke before the Newark Foundrymen's association and the metropolitan section of the American Society of Mechanical Engineers, Down Town club, Newark, N. J., Feb. 18 on "Layout and Design of the Small Modern Foundry."

George A. T. Long, Pickands, Brown & Co., Chicago, addressed the February meeting of the Quad City Foundrymen's association held in the Davenport chamber of commerce, Feb. 16 on "Fifty Years Experience In Cuopla Practice and Mixing Metals."

W. Y. Stroh, president of the Stroh Steel Hardening Process Co., Pittsburgh, sailed on the Berengaria Feb. 7 for England and the Continent. Negotiations have been initiated for the production of steel by the Stroh company in England in the near future.

W. P. Loudon, recently made assistant chief engineer of the Dayton Engineering Laboratories Co., Dayton, O., manufacturer of electrical equipment formerly was chief engineer of the automotive section of the Westinghouse Electric & Mfg. Co. East Pittsburgh Pa.

Geo. L. Drake, Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. addressed the February meeting of the Philadelphia Foundrymen's association held in the Manufacturer's club, Feb. 11. Mr. Drake discussed the development that has been made in the use of hoists and cranes in foundries.

Lloyd G. McCrum has been elected president and general manager of the Richmond Radiator Co., New York. The new directors are Noble Crandall, Hamilton Pell, James F. Curtis and Floyd W. Parsons. A. H. Schroth and W. G. Langford were elected vice presidents, the former in charge of sales and the latter in charge of purchases.

Dr. Richard Moldenke, Watchung, N. J., has returned from a trip to Europe where he investigated recent developments in introgen fixation. On Jan. 12 he delivered an address at the University of Dublin on "Cast Iron Mixtures with High Scrap Percentages." The address was given before the engineering and scientific societies of Ireland.

D. F. Crawford, vice president and general manager of the Locomotive Stoker Co., Pittsburgh, and president of the Westinghouse Union Battery Co. Pittsburgh addressed the Pittsburgh Foundrymen's association at its regular monthly meeting held at the General Forbes hotes, Monday evening, Feb. 16. His subject was "The Point of View". Before entering the industrial field, Mr. Crawford served 38 years with the Pennsylvania railroad, advancing from apprentice to general

manager, and therefore has had many opportunities to look at foundries from various points of view.

J. C. Mahannah for more than ten years connected with Kelsey Wheel Co. has been elected head of the branch at Memphis, Tenn., by the board of directors in recent annual meeting in Detroit. Mr. Mahannah was elected to succeed his father, A. E. Mahannah who died Oct. 12, 1924. Mr. Mahannah has served as secretary and treasurer for the last four years, and now will act as president, treasurer and general manager.

Homer C. Elliott has resigned as general foundry foreman of the Walter A. Wood Reaping Machine Co., Hooseck Falls, N. Y. and has accepted a position with the Pratt & Whitney Co., Hartford, Conn. as assistant foundry superintendent. Mr. Elliott was formerly connected with the Walworth Mfg. Co., Boston, in the capacity of foundry foreman and the Wollaston Foundry Co., Quincy, Mass., as general foreman.

Charles G. Brieman, engaged in the foundry, machine shop and boiler business at Juneau, Wis., since 1889 has retired, turning the establishment to his son, Charles F. Brieman. The firm, known as the Juneau Foundry & Boiler Works, does custom machine work, manufactures heating boilers, steel culverts, etc. The new proprietor has been associated with the company since his youth, with the exception of the war period, when he served in the marines three years.

C. K. Foster, vice president and treasurer in charge of the western executive offices of the American Radiator Co. has been made executive vice president. Westmore Hodges, secretary, now is vice president and secretary and director of advertising; R. B. Flershem, general manager of sales, has been advanced to be vice president in charge of sales; Stanley B. De Long, general manager of manufacture, has been promoted to a vice presidency in charge of manufacture. A. E. Swanson, formerly assistant to the president, was made a vice president and Ander Mertzanoff, assistant to the president, was advanced to be vice president in charge of planning and research.

Col. Edward A. Deeds has been made chairman of the executive committee of the Niles-Bement-Pond Co., New York, a newly created office, at the recent annual meeting. R. K. Le Blond was made chairman of the board of directors. J. K. Cullen was re-elected president. C. L. Cornell and S. V. Etherington were made vice presidents and S. Jay Edwards, until recently assistant treasurer was elected treasurer to succeed John B. Cornell who resigned, Charles K. Seymour was advanced from assistant sales manager to secretary. Colonel Deeds, new head of the executive committee, is a former vice president of the National Cash Register Co., Dayton, O., and was founder and president of the Dayton Engineering Laboratories Co. and the Domestic Engineering Co.

Obituary

Hiram A. Neel, superintendent, Michigan Steel Casting Co., Detroit, died at his home in that city Feb. 18, age 36. Funeral services were hold at Dravosburg, Pa., Feb. 21.

Anton Weiskittle, president of A. Weiskittle & Son Co., Baltimore, Md., died Feb. 11.

Alexander D. MacGill, a director of the Crane Co., Chicago died Feb. 12 at his home in Chicago at the age of 82. Mr. MacGill, who was born in Scotland, came to the United States in 1865 and was employed by the Crane Co. in 1869. He held many posts and in 1914 was made vice president in charge of finance, until his retirement a few years ago. He was the oldest employe in point of service of the company.

Joseph A. Frauenheim, organizer and former president of Iron City Sanitary Mfg. Co., Zelienople, Pa., and former general manager of the Premier Staybolt Co., died Feb. 11 in the Pittsburgh hospital following a short illness. Mr Frauenheim was born in Pittsburgh in 1875 and was educated in the local parochial schools, finishing his education in Canisius college, Buffalo. A few years later, in 1900, he organized the Iron City Sanitary Mfg. Co., and as president was located in Pittsburgh. He left that company in 1910 and was general manager of the Staybolt company until a few years ago.

Randolph M. Goldsborough, aged 51, died suddenly in Best, Texas, Feb. 20. Four weeks ago Mr. Goldsborough was elected vice president of the International Supply Co., Tulsa, Okla., and was making an inspection tour of the company's 40 stores when he died. He was born in Parkers Landing, Pa., and a few years later moved with his family to Bradford, Pa. In 1891 he became associated with the Oil Well Supply Co., Pittsburgh and in 1910 and for the 10 years thereafter was affiliated with the Union Tool Co., Los Angeles, Calif. In 1920 he returned to Pittsburgh and since that time until about a month ago had operated the Titusville Supply Co.

H. W. Hoyt, past president of the National Founders' association and active in other organizations including the National Metal Trades association, died recently at his home in California. In 1887 with Philetus W. Gates he purchased the Gates Iron Works, Chicago, of which company he was secretary and general manager until 1901 when the business was sold to the Allis-Chalmers Co. Mr. Gates was second vice president in charge of sales of this company. In 1902 he was active in the organization of the Great Lakes Engineering Works, of which company he became vice president in 1907. Several years ago he retired from active business and since has made his home in California.

Milestones of Foundry Progress

(*Concluded from Page 205*)

R. A. Pitman told of investigating the cause of shot in gray iron castings by keeping his eye close to a small opening in a permanent mold, the interior of which was lighted by the incoming metal He ascribed the difficulty to splashes at the start of pouring.

* * *

Like the good deacon in the yarn, Mr. Pitman evidently felt that the sight was worth the risk of one eye.

* * *

Carl Frederick Dietz had a splendid paper on selecting grinding wheels for foundry use.

* * *

The Lebanon Steel Foundry, Lebanon, Pa., was planning to erect an electric steel plant.

* * *

J. J. Davis then of Pittsburgh, now secretary of labor, was a member of the board of governors of the Loyal Order of Moose which appropriated $350,000 for a foundry, machine shop and printing plant.

Made Coast Agent

W. R. Quinn, formerly manager of the fuel oil department, Combustion Engineering Corp., New York, has been made Pacific coast agent for that company with headquarters in San Francisco. Mr. Quinn's territory will include Washington, Oregon and California.

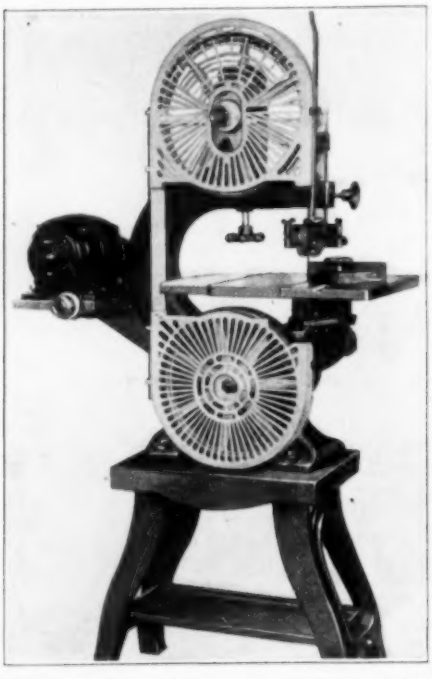
Change Company Name

The Chemical Engineering & Foundry Co., has changed their name to the Standard Cast Iron Pipe & Foundry Co. with general offices and works at Atlanta, Georgia.

Builds Band Saw

A new band saw for cutting wood, soft metals, steel and iron has been introduced by the Racine Tool & Machine Co., Racine, Wis. The blade may be directed to any desired angle by swiveling the table and saw guides, thus making it possible to cut long lengths of stock. A roller guide is mounted on the table column immediately below the cutting point, the table and lower guide being swiveled together. The upper guide is mounted on the regular guide post, and may be swiveled about the blade as a center. In this way the blade is supported above and below the work.

The swivel guides are made of two,

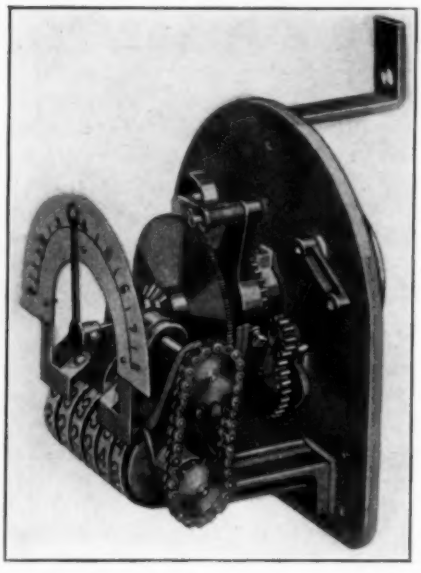


THE TABLE AND SAW GUIDES MAY BE SWIVELED

small, hardened rollers accurately ground and having ball bearings. A large roller supports the blade in the rear and takes the feeding pressure. Thumb screws and hand wheels are used for adjustments. The machine has the change speed feature.

Meter Measures Coal

A meter which measures the coal fed into a furnace through a stoker has been placed on the market by the Republic Flow Meters Co., Chicago. Operation of the instrument depends on the automatic recording of the product of the cross sectional area and the velocity of the layer of coal passing into the furnace, the meter registering the volume of coal burned. The meter is attached to the driving mechanism of the grate in such a way that the speed of the ratchet wheel is varied in proportion to the grate travel. At



MECHANISM OF COAL METER

the maximum gate height, the counter makes a complete revolution with the ratchet wheel, turning off ten units. As the gate is lowered the motion is communicated to the cam which throws two pawls out of contact with the ratchet wheel during a portion of the revolution so that the number of units turned off by the counter is decreased in proportion to the amount by which the gate is lowered. For an 8-inch maximum gate the counter turns off 10 units per revolution, at 4-inch gate height, 5 units per revolution and at 0 gate height the pawls are held from engaging the ratchet throughout the complete revolution so that the meter reading is zero.

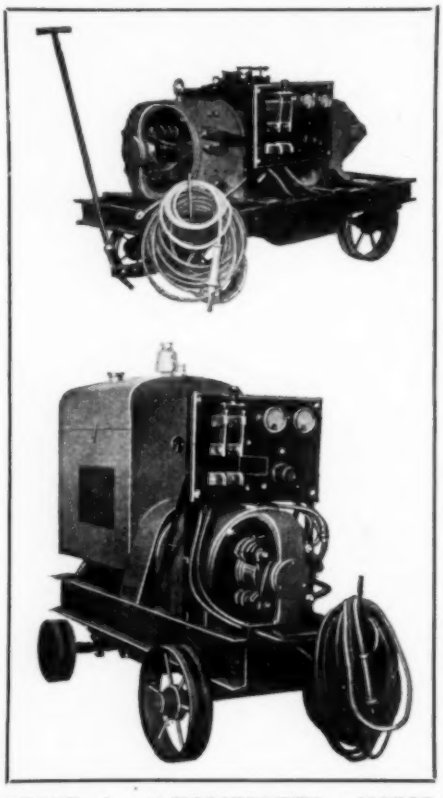
Tests have shown that the weight of a given volume of coal varies but little with graded size, a fact which was

THE METER IS ACTUATED BY SPROCKET AND CHAIN

taken into consideration in the design of the meters. However, if greater accuracy is desired in the meter readings, the coal is sampled at predetermined intervals to give the average weight per cubic foot.

Designs Welding Machine

The Wilson Welder & Metals Co., Inc., Hoboken, N. J., has introduced a portable motor driven and a gasoline engine driven electric welding machine, designed for use in foundries, steel mills, locomotive and car shops, etc. The generator is self



ABOVE—A 10-HORSEPOWER MOTOR DRIVES THE GENERATOR—BELOW—THE GASOLINE ENGINE IS RATED AT 15 HORSEPOWER

excited and no ballast resistance is used. All regulation of current is accomplished by turning the knob of the field rheostat. The motor driven machine is designed to turn out fast work with electrodes up to ¼-inch in diameter. The generator is designed to give full load of 250 amperes when welding, and the current will not rise over 10 per cent of that on short circuit. The welding voltage is 25 and the open circuit voltage is 50. The motor is standard 10 horsepower furnished for any voltage, phase of frequency.

The gasoline-driven machine is designed for electrodes up to 3/16-inch in diameter and has been designed to give a full load of 200 amperes. The gasoline engine is four cylinders, 15 horsepower with a speed of 1500 revolutions per minute. A view of the two machines is shown in the accompanying illustration.

Hydraulic Machine Makes Axle Boxes

Methods of molding the new British standard axle box were demonstrated at the International Foundry Trades exhibition by the Universal System of Machine Molding and Machinery Co., Ltd., London. This work was performed on a hydraulic roll-over molding machine as shown in the accompanying illustration. The machine shown in at the left has been rolled over and the mold drawn. This machine makes the drag side of the mold and is completely rotated from the trunnion under pressure. When upside down, the exhaust is given to the pressure piston and the mold is drawn off the pressure plate as shown in the illustration. In making this particular piece, it may be seen that two loose pieces follow the main green sand core in pattern drawing, the pieces being taken off after the pattern is drawn. This mold has a particularly thin rib left in the green sand without nails or points of support of any description, the ribs standing up in the wash of metal.

The pattern plate shown on the machine is of special interest since it is made without any machining. It also may be noticed that a stripping plate is provided to draw the thin rib of sand shown in the mold. The stripping plate moves only a small distance from the pattern plate during the drawing, it being fixed through and held with nuts on the reverse side of the pattern plate.

LARGE CAPACITY BALL BEARINGS SUPPORT THE LOAD

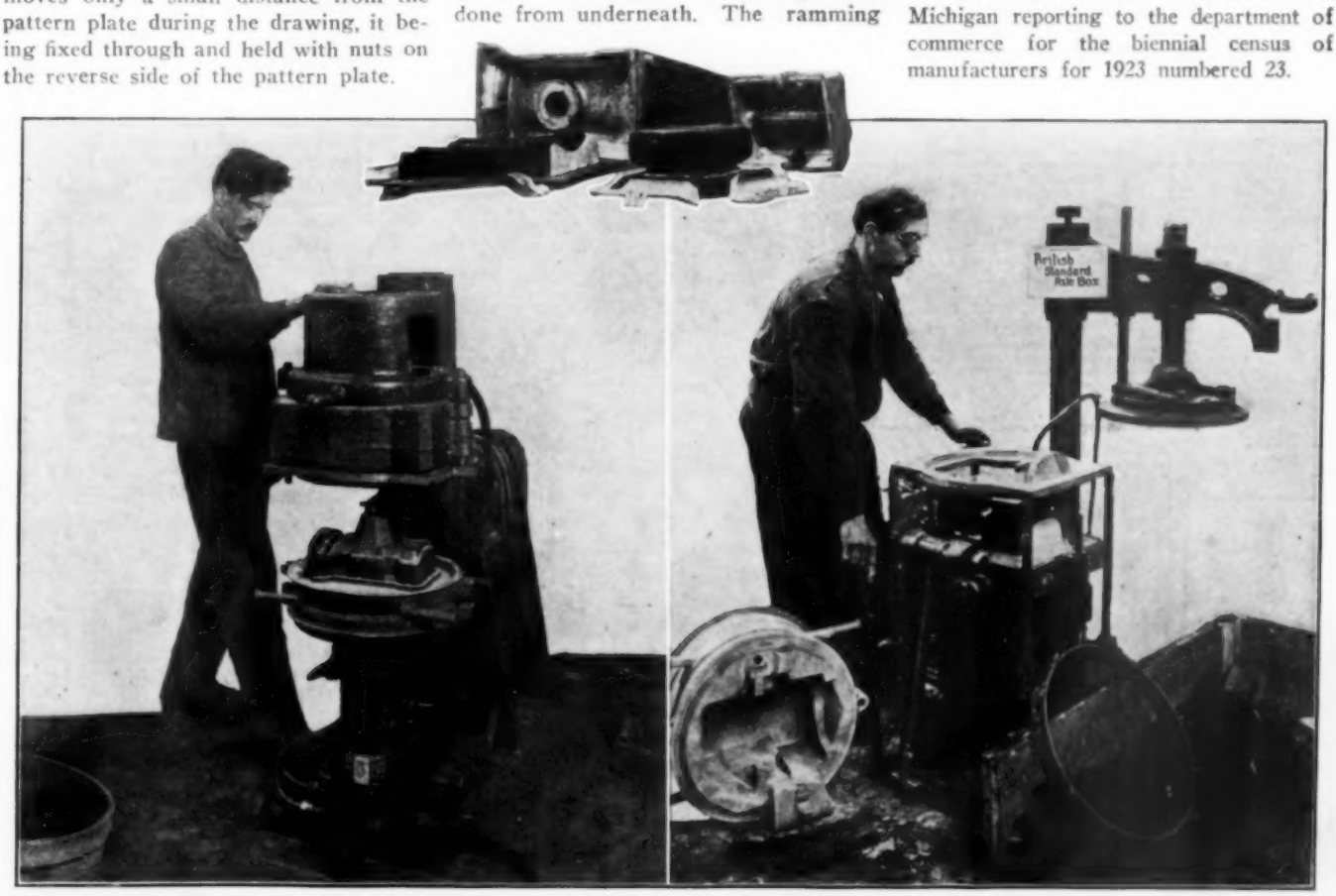
The molding machine is operated hydraulically at a pressure of 750 pounds per square inch. The cope side of the bottom half of the axle box is shown in the accompanying illustration. Near the mold a loose piece with an undercut is shown. The type of machine has been found well adapted to this type of work. The pattern plate in this case also is worth notice, the plate being made without any machining as is the stripping plate which is shown in the pattern drawing position. The machine is of an entirely new type, the ramming being done from underneath. The ramming and pattern drawing pistons are operated by one lever and one valve box.

The coreboxes and cores for the axle box are shown in the accompanying illustration. The boxes are also made without machining and are of curious construction. They are made of small loose pieces with a covering shell.

Block Has Ball Bearings

A new, ball-bearing chain block, in which large capacity ball bearings are used, recently has been placed on the market by the Yale & Towne Co., Stamford, Conn. The design provides for two, chrome-alloy, ball bearings to support the load sheave shaft. The ball bearings are arranged to take the entire weight of the load and to withstand the thrust and shock of trust and overload surges. The bearings are enclosed in small chambers, and provision is made to prevent dust and grit from entering them. Continuous lubrication of the bearings, driving pinion, shaft and driving gears is a feature of the new block. The chain blocks are provided with electrically welded chain, detachable shackles, and safety hooks. They are being built in a number of sizes ranging from ¼ to 20 tons.

Stove and furnace manufacturers in Michigan reporting to the department of commerce for the biennial census of manufacturers for 1923 numbered 23.



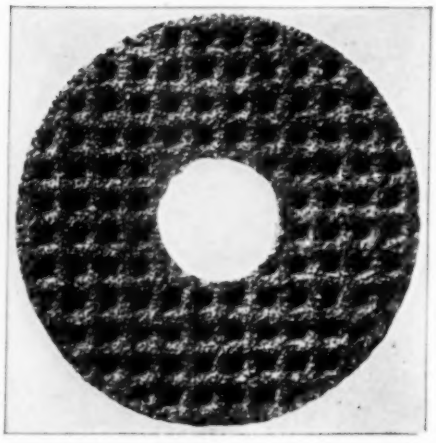
LEFT—HYDRAULIC MOLDING MACHINE WITH PATTERN DRAWN—ABOVE—CORE BOXES AND CORES USED IN MAKING STANDARD AXLE BOXES—RIGHT—RAMMING AND PATERN DRAWING PISTONS OPERATED WITH ONE LEVER

Gas Producer Integral with Furnace

A brass melting furnace with integral gas producer has been introduced by the Combustion Engineering Corp New York. This brass melting furnace consists of a pit or melting chamber in which the crucibles are set. The coal is burned in a gas producer, which is integral with the furnace, and the gas produced is burned in the pit or the combustion chamber. Instead of going directly to the stack, the gases leaving the combustion chamber are led through a series of recuperative tile, so designed that incoming air flows in a transverse direction in separate passages, thus allowing a part of the heat of the waste gases to be absorbed by the incoming air. This preheated air is led through ducts to the burner and there mixed with the gas from the producer and burned.

Special brick are used for the recuperators, the brick having a square hole extending from end to end and from top and bottom open transverse channels. Rows of several such blocks are laid end to end and side by side forming several adjacent ducts lengthwise of the furnace which serve as flues for the waste gases. Rows are laid on top of the first and the transverse channels in the lower surface in combination with those of the upper surface of the first row form flues for the secondary air. The flue system thus produced utilizes a large surface for the transmission of heat, and when bonded together, is gas tight. The ends are flanged and mortised to give continuous, tight joints, and equipped with doors for cleaning the gas flues.

Several advantages are claimed for this type of furnace including the use of cheap coal, high production rate, small amount of labor necessary, low fuel consumption and high quality of the prod-



HOLES GO PRACTICALLY ALL THE WAY THROUGH THE DISK

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deCourcy Browne, president of deCourcy Browne, Inc., New York, metallurgical engineers and importers of ferroalloys, is spending several weeks in Miami, Fla.

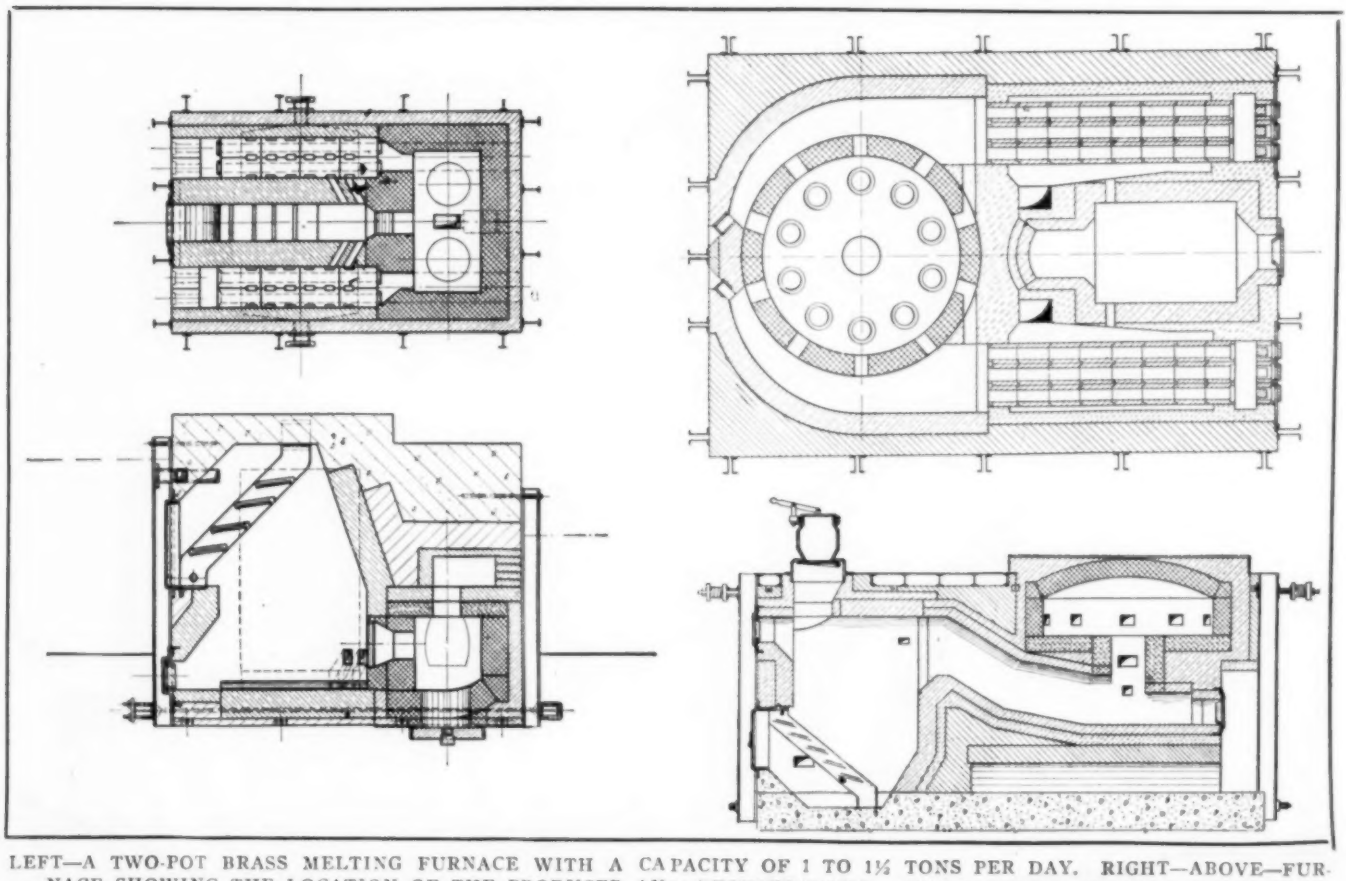
Disk Is Corrugated

A recent development in the field of abrasives disks has been introduced by the Gardner Machine Co., Beloit, Wis. The disk is designed especially for use upon work with large surfaces to be ground and also is said to eliminate excessive heat generation. The surface of the disk is corrugated with holes which go practically through the disk to the cloth backing, as shown in the accompanying illustration. The advantages claimed for the disk include rapid and cool cutting qualities due to the chip clearance afforded by the deep corrugations.

Value Foundry Products

The biennial census of manufactures, 1923, compiled by the department of commerce shows products valued at $354,708,016 made by foundries, $1,280,382,726 by machine shops, and $578,026,024 by plants operating foundries and machine shops combined.

Foundries producing miscellaneous nonferrous castings reported products valued at $44,753,568 according to data collected by the department of commerce in its 1923 biennial census.



LEFT—A TWO-POT BRASS MELTING FURNACE WITH A CAPACITY OF 1 TO 1½ TONS PER DAY. RIGHT—ABOVE—FURNACE SHOWING THE LOCATION OF THE PRODUCER AND RECUPERATORS. BELOW—10-TON MELTING FURNACE FOR MELTING BRASS OR NONFERROUS METALS EQUIPPED WITH GAS PRODUCER

Equipment Inquiries Better

Lists Extant Indicate Large Potential Business—Market Is Spotty—Many Manufacturers Have Experienced Decline In Volume Since First of Year

INQUIRIES for foundry equipment are being brought out in larger numbers in several distributing centers, considerable business now being in sight. However, manufacturers are finding users of equipment reluctant to close on material for plant additions, and replacements are being purchased only when necessary. Business has not maintained the volume anticipated earlier in the year, a slight but steady decline being noted during January and February. Men of the industry are not unanimous in their predictions as to when the situation will change for the better, but many feel that improvement may be expected in the near future. As in the foundry industry, where a few plants making a particular line of products are working almost at capacity, a few builders of equipment are securing business on an entirely satisfactory basis. Few plant additions are being contemplated.

Buyers Delay, Await Business Pickup

FOUNDRIES in the central west continue reluctant to place new equipment. Business with the foundries is spotty. The Illinois Central railroad may include a small brass foundry in its expanson program at Paducah, Ky. The National Engineering Co., Chicago, has sold sand mixers to the Jackson Furnace & Foundry Co., Jackson, Mich.; American Steel Foundries, East St. Louis, Ill.; American Engineering Co., Philadelphia, and Sims Mfg. Co., Erie, Pa. The Maynard Electric Steel Castings Co., Milwaukee, has purchased sandblast and dust arrester equipment as has the Jenkins Machine Co., Sheboygan, Wis., from the Pangborn Corp., Hagerstown, Md. The Axelson Machine Co., Los Angeles has secured sand-blast equipment from the same manufacturer. The Dalton Foundries, Inc., Warsaw, Ind., has awarded a contract for a plant addition costing approximately $55,000 and requiring the employment of 100 additional molders and coremakers.

New England Inquiry Better

EQUIPMENT inquiry has shown marked improvement recently in New England. Crane manufacturers are working on four or five attractive prospects which are expected to be closed within the next week or ten days. The Chase Metal Works, Waterbury, Conn., is receiving bids on annealing oven equipment which will cost about $20,000. The Bullard Machine Tool Co., Bridgeport, Conn., is in the market for an electric furnace. Recent sales of molding machines include several to the Lowell, Mass., plant of the Saco-Lowell Shops, costing approximately $6000, six or eight machines to Pratt & Cady, Hartford, Conn., and molding machines and other equipment costing in excess $10,000 for the Guerney Heater Co., Framingham, Mass. The Waterbury Mfg. Co., Waterbury, Conn., has purchased a dust arrester installation from the Pangborn Corp., Hagerstown, Md. Foundry supply dealers report good business in New England during the past two weeks.

Pittsburgh Sales Slow

FOUNDRY equipment inquiries in the Pittsburgh territory are more voluminous than sales, the latter being spasmodic. The Mt. Vernon Car & Mfg. Co., Mt. Vernon, Ill., has placed an order for four large molding machines with the Herman Pneumatic Machine Co., Zelienople, Pa. This molding machine manufacturer also reports sales of one each to the following: Wheeling Bronze Casting Co., Wheeling, W. Va.; S. Ferguson & Son, Hoboken, N. J.; and the Locomotive Stoker Co., North Side, Pittsburgh. The Weil-McLain Co., Michigan City, Ind., has ordered three additional machines. Inquiries for molding machines are fairly plentiful but hesitancy is encountered in closing. Cupola inquiries have furnished an interesting feature of the recent market. The Iron City Sanitary Mfg. Co., incorrectly referred to in the last issue as the Ohio City Mfg. Co., Zelienople, Pa., still is negotiating for three cupolas, two blowers, several ladles, etc., and may close soon. The Pittsburgh Engineering Co., Jeannette, Pa., has been considering the purchase of a cupola and the Milton Iron Co., Jackson, O., wants a cupola in addition to two cranes, one 5-ton and one 10-ton. The J. S. McCormick Co., Pittsburgh, sold a 42-inch cupola, together with lining, to the Harmony Foundry Co., Harmony, Pa. George T. King, Corpus Christi, Tex., bought a cupola from the Whiting Corp., Harvey, Ill., together with ladles and other miscellaneous equipment. This manufacturer also sold the University of Wisconsin, Madison, Wis., one cupola, and a 12-ton helical worm-geared ladle to the National Roll & Foundry Co., Avonmore, Pa.; a 4-ton ladle of the same type to the National Tube Co., McKeesport, Pa., and a 3-ton ladle to the Taylor-Wilson Mfg. Co., McKees Rocks, Pa. The United Engineering & Foundry Co., Pittsburgh, recently purchased a sand mixer, and the Bronze Die Casting Co., Pittsburgh, bought an electric sand sifter. A foundry operator is inquiring for a second-hand blower and a tumbling mill. The General Electric Rochester, N. Y., bought an electric furance. The Bethlehem Steel Co., Bethlehem, Pa., has purchased an electric furnace from the Pittsburgh Electric Furnace Corp., Pittsburgh. Prospective purchasers of foundry equipment include the Reading Foundry & Supply Co., Reading, Pa.; the Louisville Brass Foundry, Inc., Louisville, Ky.; W. W. Truxell Foundry Co., Jeannette, Pa.; the McKim Foundry & Machine Co., Lockport, N. Y., and the Pratt & Letchworth Co., Buffalo.

Improvement Slight in East

WHILE a slight improvement is noted in the eastern foundry equipment field, trading still is far from brisk. More flasks, ladles and smaller supplies are being bought, which is indicative of improved operations and a further increase in the purchase of equipment. Little business is noted in core ovens, tumbling barrels, mixers and cupolas, and molding machines are being purchased only in a limited way. Among the few new projects noted is a $50,000 plant to be erected in Long Island City, by the Renaissance Bronze & Iron Works, 3876 Park avenue, New York. The company is inquiring for some of the larger equipment included a handpower crane. Inquiries for other items are expected to be brought out shortly. A large buyer of late is the Doehler Die

Casting Co., Brooklyn. This company has increased and partially divided its white metal department among branch plants at Pottstown, Pa., Batavia, N. Y., and Toledo, O., has purchased 35 additional die casting machines. The Somerville Stove Works, Somerville, N. J., previously noted as contemplating a new plant at Elizabeth, N. J., has postponed action on this project. It is understood that the plant eventually will be erected, but not until building costs are lower. The acquisition of the Gould Coupler plant at Rochester, N. Y., by the Symington Co., that city, is expected to result in few changes necessitating new equipment. The Brass Goods Mfg. Co., 345 Eldert street, Brooklyn, is inquiring for a horizontal type air compressor, 10 to 12-inch stroke. Work will be started this spring by the Reading Foundry & Supply Co., Reading, Pa., on an addition.

Cleveland Buyers Delay

A DECLINE in the sale of foundry equipment in the Cleveland territory has been noted since the first of the year. The failure of general business conditions to warrant as high an operating capacity as was expected at the beginning of the year has caused many users of equipment to defer making previously contemplated replacements and extensions. While the number of inquiries brought out during the past two weeks has not been heavy, numerous lists remain before the trade. Several manufacturers feel confident that much of this business will be closed in the near future, while others have no prediction to make on the time this equipment will be sold. Molding machines seem to be in greatest demand in this territory. The Hartwick Stove Co., Cleveland, Tenn., and the Oklahoma Steel Casting Co., Tulsa, Okla., have purchased tumbling mills and the W. O. Taylor, Inc., Buffalo has secured sand blast equipment from the W. W. Sly Mfg. Co., Cleveland. The Packard Motor Car Co., Detroit, has closed on sand-blast and dust arrester equipment and the General Motors Co., Detroit, has purchased sand blast equipment for the Harrison Radiator Co., Lockport, N. Y., from the Pangborn Corp., Hagerstown, Md. The Eastern Steel Castings Co., Newark, N. J., has installed a furnace made by the Mayor Fuel Saving Furnace Co., Cleveland. The Niagara Falls Smelting & Refining Corp., Buffalo, is in the market for a briquetting machine for making metal bricks either 12 x 5 x 5 or 11 x 4 x 4.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Reading Foundry & Supply Co., Reading, Pa., is drawing plans for a plant addition.

Juneau Foundry & Boiler Works, Juneau, Wis., is making plans to increase the output.

Hartford Foundry & Machine Co., Hartford City, Ind., will be moved to Montpelier, Ind.

Somerville Iron Works, Chattanooga, Tenn., is planning an addition to its plant.

Modern Pattern Co., Canton avenue, Toledo, O., is building a 1-story addition.

American Castings Co., Ninth avenue, Birmingham, has increased its capital from $50,000 to $100,000 and will build an addition.

Moline Foundry Co., Moline, Ill., has changed the name to the Moline Foundry & Machine Co.

Kalamazoo Stove Co., Kalamazoo, Mich., has awarded a contract for a new building to cost approximately $20,000.

P. & B. Foundry Co., Indianapolis, has leased a building at 424 South Pennsylvania and will produce gray iron castings.

Central Foundry Co., Newark, N. J., soon will start work on improvements and extensions costing $10,000.

Federal Metal Bed Co., Hoboken, N. J., is having a 1-story foundry 125 x 136 feet erected by the H. K. Ferguson Co., Cleveland.

McKim Foundry & Machine Co., Lockport, N. Y., has increased its capital from $100,000 to $200,000.

Renaissance Bronze & Iron Works, 3876 Park avenue, New York, is to build a plant costing approximately $50,000.

Barker & Co., Scranton, Pa., has been taken over by Alex Robinson & Son, who are conducting a brass and aluminum foundry.

Sterling Brass Co., Cleveland, is revising plans for a new factory having two stories and basement.

Milton Iron Co., Jackson, O., is drawing plans for a foundry 100 x 200 feet. A cupola and 5 ton crane will be purchased.

Foundry owned by Whitely W. Truxell, Jeannette, Pa., was badly damaged by fire Feb. 4.

Davis Pipe & Fttings Co., 830 North Forty-sixth street, Birmingham, Ala., has bought the plant of the Iron City Pipe & Foundry Co. and after alterations and additions will continue its operation. Ben Davis is president.

Crescent Foundry Co., 2852 Lyon street, St. Louis, L. W. O'Neill president, will build a 1-story foundry 95 x 180 feet.

Beans Foundry Co., Martins Ferry, O., George Bean, manager, is having plans drawn for a 1-story foundry building 100 x 100 feet.

Central Brass Mfg. Co., 6203 Cedar avenue, Cleveland, O., will start construction at once of a plant at 2956 East Fifty-fifth street.

Asheville Supply & Foundry Co., Biltmore, N. C., R. D. Hildebrand, president, will build a plant this year and a steel warehouse and fabricating shop.

S. H. Barnum Foundry Co., Hartford, Conn., has been reorganized and has changed the name to the Barnum Machine & Pattern Works. The foundry has been discontinued.

American Steel Foundries, Indiana Harbor, Ind., has obtained a building permit for a pattern storage building. McClintic-Marshall Co., Pittsburgh, will erect the building.

Beaumier Iron Works, Brenham, Tex., has let a contract for an addition 55 x 75 feet, one story, to increase its foundry and machine shop capacity.

McWayne Cast Iron Pipe Co., 3600 Eleventh avenue, North, Birmingham, Ala., has started construction of the second unit of its new foundry plant. Capacity will be doubled by improvements now under way.

Lin Shao Heng, Fukien capitalist, Shuipu, Foochow, Fukien, China, is organizing a modern iron foundry under name of Tien Yuan Iron Foundry. Permission has been sought from the Fukien authorities.

Mechanics Iron Foundry Co., 38 Kemble street, Roxbury, Mass., is having plans drawn for a foundry 105 x 150 feet. H. E. Gibby is treasurer. E. W. Lawson, 6 Beacon street, Boston, is the architect.

Buckeye Iron & Brass Works, Dayton, O., has discontinued its iron foundry and will specialize in brass whistles, gages, steam fitters supplies, etc. New equipment is being added.

Lincoln Foundry Co., 1848 Vine street, Lincoln, Neb., has been established to do a general jobbing business in semisteel, heat resisting and high finish gray iron castings by A. C. Porter and associates.

Victor Stove Works, High Point, N. C., has been incorporated with authorized capital of $100,000 and $60,000 subscribed, by A. Sherrod, W. A. Sherrod, Guy Ralston and J. W. Montgomery.

A new brass and aluminum foundry and nickel plating plant has been started at Owosso, Mich. Fred Glander, formerly connected with the Standard Machine Co. heads the enterprise.

Metal Castings Co., Phoenixville, Pa., is to manufacture nonferrous castings and later will operate a gray iron foundry. The buildings now are complete and the company is buying additional equipment. C. S. Wilmot is one of the officers.

Hardy & Newsom, La Grange, N. C., J. A. Daugherty general manager, are building a foundry plant to have capacity of 6 tons per hour which is much in excess of the present plant. A machine shop will be constructed when the foundry is completed.

Excel Pattern & Foundry Co., 2057 West Van Buren street, Chicago, has been incorporated with $15,000 capital to manufacture patterns by William Elsner, George Grassmeyer and P. J. Murphy. Reliance State bank, Madison street and Ogden avenue, is correspondent.

G. L. Anderson Brass Works, Inc., Birmingham, Ala., has been incorporated with $100,000 capital to operate a brass foundry. E. T. Shuler, Gadsden, Ala., is president, G. L. Anderson vice president and J. E. Anderson secretary.

Property of the Kenova Mine Car Co., Kenova, Pa., located on the Norfolk & Western, the Baltimore & Ohio, and the Chesapeake & Ohio railroads, with right of way to the Ohio river, is being offered for sale. It includes land, buildings and machinery. Buildings are of brick and consist of a foundry; storeroom; machine, erection and pattern shops; also office building and complete sprinkler system.

Hand Made Is the Vogue, But SERVICE IS A BETTER BET

SALES ideas and conceptions of what really constitute good selling points sure do vary. Remember that yarn of the darky who was selling the mule to a dusky friend? The mule's good points had been explained, the prospect found out to his satisfaction that the animal was provided with a self-starter and that the number of teeth present indicated a model not yet entirely obsolete; but in ambling down the road, the mule ran *wham* into a telephone pole. The would be purchaser thought he saw a defect.

"Huh!" said he, "that mule ahm blind 's mole."

"No 'e aint, that tha mule jes don' give a dam," was the salesmanlike comeback of the owner. Of course, the important point as to whether the sale was made is not given, but one can draw an inference.

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ALONG that line, I received a piece of sales literature put out by a firm that runs a foundry as one of its important departments. Presumably this was written by a sales manager or advertising man who never saw the inside of a casting shop. Let's hope, for the ultimate success of the sales appeal that it went only to prospective buyers who were equally uninformed. With the whole range of really worthwhile points to mention, observe what was selected for this sales leaflet:

This is a new design of especial strength and appearance. Every part is made and finished in our own factory. The castings are of superior grade, HAND MOLDED from plate patterns in our own foundry.

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HAND molded—what a feature to brag about! If the writer of this advertising copy really is consistent he insists that his breakfast porridge be made from oats cut with a sickle, threshed with a flail, carried to market in a basket and flattened with a hammer. Hand made, exclusive design, imported model and all that individualistic bunk may serve to sell millinery, ladies frocks or perhaps even the balloon-type pants affected by the younger set of the he-persuasion, but applied to castings? I leave it to you! Primarily the buyer is not interested in how the product is made, but rather in what it is and what it will do. If *any* point in the manufacturing process is put forward as a sales argument, is not the regularity, even section and accuracy of machine made castings worthy of attention? That is if this phase is mentioned at all in selling.

P. T. Barnum Says/

THERE is as much diversity in our brains as in our countenances.

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AN UNDERSTANDING of what the customer wants is worth money. I recall an operating man who was projected into the foundry business more or less by accident, but who has made good through this understanding of the buyer's wants. He inherited a small-town waterworks plant from his father. This he managed ably and administered to the best interests of the community and the profit of the owner, until a statewide public service utility bought him out. He had been interested in a local foundry which made stove castings. Business slumped and this former waterworks owner took over the foundry, a small shop employing about a dozen men. He concieved an idea.

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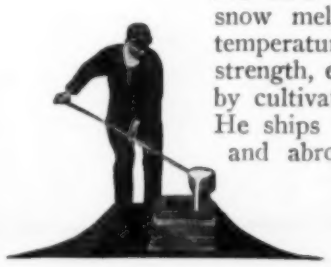
HIS idea simply stated, was to provide a frost-proof protective box for underground service meters on water lines. He developed a cast-iron cover which necked up to a smaller lid with a locking device. This cover may be fitted over the top of standard size vitrified tile. The meter is set in the inside of the covered tile, the surrounding air space providing protection against freezing while the locking lid affords access to the meter for reading. Did our converted foundry man sell these meter boxes, which he patented, by stating that they were hand made with loving care? Not much. He sold them on pictures showing snow melted from the lids by the temperature inside, by figures on strength, examples of accessibility and by cultivating waterworks executives. He ships them all over this country and abroad. His foundry is busy.



Phineas, Jr